



Dipartimento di Scienze Economiche, Matematiche e Statistiche

Università degli Studi di Foggia

Determinants of growth in Italy. A time series analysis

Stefania Villa

Quaderno n. **24/2005**

Quaderno riprodotto al
Dipartimento di Scienze Economiche, Matematiche e Statistiche
nel mese di dicembre 2005 e
depositato ai sensi di legge

Authors only are responsible for the content of this preprint.

Dipartimento di Scienze Economiche, Matematiche e Statistiche, Largo Papa Giovanni Paolo II, 1,
71100 Foggia (Italy), Phone +39 0881-75.37.30, Fax +39 0881-77.56.16

DETERMINANTS OF GROWTH IN ITALY

A TIME SERIES ANALYSIS

Stefania Villa*

*Dipartimento di Scienze Economiche,
Matematiche e Statistiche
University of Foggia*

Abstract

This paper investigates the macro-determinants of growth in Italy in a time series framework, from 1950 till 2004.

The analysis of economic growth, started with the Solow's (1956) and Swan's (1956) famous contributions, has developed rapidly since the mid 1980's.

The empirical literature follows two main approaches: growth accounting and growth regressions. In this paper the empirical approach starts with a parsimonious specification of the growth equation and then it analyses extended models. The initial specification is consistent with the standard neoclassical model and includes human capital. The extensions involve the introduction of a set of policy and institutional factors potentially affecting the Italian economic performance. In relation to econometric techniques, we use the error correction model (ECM) representation: in a time series framework, it provides evidence on the existence of a stable long-run linear relationship between growth and its determinants.

The main results are the following: investment is the key source of economic growth; time series properties of the variables of interest and regression analysis provide evidence in favour of endogenous growth models in Italy and the only variable that seems to be robustly correlated with growth, according to the Extreme Bound Analysis, is government consumption, which affects negatively the growth rate.

JEL classification: C22, O11, O40.

Key words: Economic Growth, Time-Series Models.

* Corresponding Author. E-mail: s.villa@unifg.it

1 Introduction

The analysis of economic growth has come a long way since Solow's (1956) and Swan's (1956) famous contributions; developments have been particularly rapid since the mid 1980's.

Studies about growth are looking for patterns and systematic tendencies that can increase the understanding of the growth process, in combination with historical analysis, case studies, and relevant theoretical model.

The availability of standardized and reliable data sets has led to a burgeoning empirical literature, according to two main approaches: growth accounting and growth regression. In the first approach, the level of real output is decomposed into its constituent parts: the contribution of factor inputs and of residual total factor productivity. Growth accounting tries to establish how much growth can be attributed to the accumulation of factors of production and therefore the importance of "unexplained" growth.

Growth regressions have been an extremely popular means of testing causes of growth. The neoclassical model is the cornerstone of economic growth literature (Solow, 1956). Mankiw, Romer and Weil (1992) tested the Solow model augmented with human capital and provide evidence in favour of it.

The "new growth economics" theories (e.g. Romer, 1986; Lucas, 1988; Romer, 1990) emphasise the endogenous determination of growth rate, which is determined within the model, and therefore can be affected also by economic policies, instead of being driven by exogenous technological progress. Permanent changes in economic parameters can alter the economic rate of growth permanently. A huge amount of empirical works has tested models of endogenous growth [see Barro and Sala-I-Martin (2004) for survey].

In the lack of complete formal models, the answer of which theory can be accepted has become empirical: attention has shifted to the relation between theory and data. But most of empirical works reach different conclusions.

The standard approach to growth determinants consists in running cross-country or panel regressions. In this paper, we concentrate on a time series analysis of determinants of growth in Italy. We prefer to follow what Durlauf et al. (2004) suggest: "At first glance, the most natural way to understand growth would be to examine time series data for each country in isolation". National growth rate appears to be correlated with a variety of economic, social, and political variables, and many of those are affected by economic policies. Recent perceptions of relatively poor Italian economic performance have led to a renewed interest in the causes and factors of Italian economic growth.

The empirical approach starts with a parsimonious specification of the growth equation and then it analyses of extended models. The initial specification is consistent with the standard neoclassical model and includes human capital. The extensions involve the introduction of a set of policy and institutional factors potentially affecting economic efficiency. In relation to econometric techniques, we use the error correction model (ECM) representation: in a time series framework, it provides evidence on the existence of a stable long-run linear relationship between growth and its determinants, which is in itself interesting from a theoretical point of view.

The great problem underlying the growth regressions is the lack of accepted formal theoretical models that can accommodate the wide range of variables that are often included as regressors. There still remains a large gap between the formal models and the informal but often complex mechanism that are tested in empirical works. The problem faced by empirical growth economists is that growth theories are not explicit enough about what variables belong to the “true”¹ regression. Sensitivity analysis represents, in the related literature, a “compelling step”; for that reason, we employ an extreme bound analysis.

The main findings reported in this paper are:

- i) investment is the key source of economic growth, according to both growth accounting and regression analysis;
- ii) time series properties of the variables of interest and regression analysis provide evidence in favour of endogenous growth models in Italy;
- iii) given that, economic policies play a fundamental role in determining Italian economic performance. The only variable that seems to be robustly correlated with growth is government consumption, which affects negatively the growth rate.

Pros and contras of time series and cross-country approaches

The empirical literature concerning determinants of growth uses two different econometric approaches: cross-country and time-series regressions. In this subsection, we present evidence from both methodologies, arguing that the time series approach is more useful in analysing specific aspects of this topic.

The cross-country approach requires averaging out variables over a time period of generally thirty years and using them in cross-section regressions in order to explicate cross-country variations of growth rates. A huge number of studies have chosen this methodology: for example, Barro (1991), Kormendi and Meguire (1985), Grier and Tullock (1989), Mankiw, Romer and Weil (1992), Sala-I-Martin (1997).

The time series approach has been used by Morales (1998), Demetriades and Hussein (1996), Antonelli, Marchionatti and Usai (2000), among the others.

There are several sources of bias of both time-series and cross-section studies.

We can mention some limitations of the cross-country methodology. First, cross-country or panel regressions suffer of parameter heterogeneity. The vast majority of empirical growth studies assume that the parameters that describe growth are identical across countries. It means that a change in “the level of a civil liberties index has the same effect on growth in Us as in the Russian Federation”². Panel data approaches have addressed one aspect of this problem by allowing for fixed effects³, though they could not address this more general question.

Furthermore, cross-country approach refer to the “average effect” of a variable across countries; this limitation is particularly severe when testing causality as the possibility of differences in causality patters across countries are likely, as Arestis and Demetriades (1996) pointed out.

¹ Sala-i-Martin (1997).

² Brock and Durlauf, (2001).

³ Evans, (1998).

Finally, the results of cross-country or panel regressions crucially depend on the selected sample; for example, convergence is or is not supported depending on the selected countries (OECD, Africa, Northern and Southern regions of Italy, etc.).

The disadvantage of time series approach is the constraint of the availability of the data, mainly for developing countries (this is not the case). Even when reliable data are available, some variables, like political stability, inequality index, and maintenance of property rights display little time variation. Other variables do not change at all: for example, geographical and religious variables. However, this study focuses on the effects of inputs and economic policies on growth and in which direction they can be modified in order to guarantee higher level of output and better economic performance.

Until recently, the study of growth and the study of business cycle have been largely separated from each other with little cross-fertilisation of ideas between them. Theoretically business-cycle literature studies deviations of output from a trend, while the growth literature analyses the slope of the trend⁴. With the emergence of endogenous growth theory, however, a growing body of research⁵ that tries to explore the potential linkages between secular and cyclical activity has come out. Econometric modelling of a growth process in a time series framework can be contaminated by business cycle dynamics, since measured output is a noisy indicator of potential output. Two alternative solutions have been suggested⁶: one consists in constructing a series for potential output. The other requires the analysis of the time series properties of all the series in order to see whether these properties are compatible with the existence of a long-run relationship. The first method is not entirely satisfactory⁷; therefore we apply the second.

Durlauf et al. (2004) emphasized that time series analysis is not recommended when examining developing countries and using lags of output or the growth rate as explanatory variables. But our study does not consider these aspects.

Time series variation can be informative for some hypothesis. Jones (1995) and Kocherlakota and Yi (1997) presented how time series model can be used to discriminate between exogenous and endogenous growth theories. Furthermore the theory relating to causality is based on time-series analysis (Granger, 1963).

The information provided by time series is also very useful for variables that have varied a good deal over time, such as openness and inflation.

The structure of the paper is as follows: the growth accounting approach for Italian economy is examined in section 2; section 3 reviews the theoretical literature; section 4 contains estimates based on time series regressions for the period 1950-2004. Section 5 presents the extended model theoretically and empirically. In section 6 robustness analysis is performed in order to solve the problem of model uncertainty.

⁴ Fatás, A. (2000a). For some aspects, this dichotomy seems normal, with diverse theories providing insights into macroeconomic movements over different horizons. But for other aspects, there are important interactions between growth and business cycles.

⁵ Canton, 1996; Fatas, 2000a and 200b.

⁶ Temple, J., (2000a).

⁷ Smyth, (1992).

Section 7 employs a simple time series test of endogenous versus exogenous growth models. Section 8 contains some considerations about causality; final section concludes. Some descriptive statistics are reported in the appendix.

2 Growth accounting for Italian economy

Generally, growth accounting is considered as a preliminary step for the analysis of fundamental determinants of growth⁸. In the 1950s and 1960s the issue of determinants of growth was a big concern for economists, with intense interest in developments in growth theory, and major growth accounting exercises being undertaken.

A production function with three inputs (capital, labour and technology) is analysed in order to assess the contribution of each input to growth. The contribution of technological change (the residual) is a “measure of our ignorance”: it is computed by the difference between the growth rate of GDP and the part of the growth rate that can be “accounted for” by the growth rate of capital and labour. The estimates of the so-called total factor productivity (TFP) do not involve econometric estimation⁹.

Solow (1957), Denison (1962) and Jorgenson and Griliches (1967) presented the basics of growth accounting. The standard approach starts with the aggregate, two-factor, twice-differentiable production function:

$$Y = F(A, K, L)$$

where A is a measure of the level of technology, K is the capital input and L is the quantity of labour. Differentiating with respect to time and dividing by Y yields, after rearrangement of terms:

$$\left(\frac{\dot{A}}{A}\right)\left(\frac{F_A A}{Y}\right) = \left(\frac{\dot{Y}}{Y}\right) - \left(\frac{\dot{K}}{K}\right)\left(\frac{F_K K}{Y}\right) - \left(\frac{\dot{L}}{L}\right)\left(\frac{F_L L}{Y}\right) \quad (1)$$

where F_K and F_L are the factor marginal products; under perfect competition, they are equal to factor prices.

Clearly the size and the stability over time of the residual depend on the form of the production function; on proper measurements of the inputs and adjustment for their quality changes¹⁰; and on the importance of variables, different from K and L , not considered in the production function¹¹. Different theories offer very different conceptions of TFP. These range from changes in technology to the role of externalities, changes in the sector composition of production, and the degree of competition.

Table I reports some exercises of growth accounting for Italy.

⁸ Barro, (1999).

⁹ An alternative approach may consist in econometric estimates of TFP, but as Barro (1999) pointed out, the usually preferred approach is the one represented in equation (1).

¹⁰ Concerning physical capital, Jorgenson (1963) and Jorgenson and Griliches (1967) were the first to develop aggregate capital input measures that took the heterogeneity of assets into account.

¹¹ Nadiri, I., (1970).

Table I. Growth Accounting results (percentages)

| | | Source | GDP growth | Share contributed by | | |
|---|-----------|--|------------|----------------------|--------|------|
| | | | | Capital | Labour | TFP |
| 1 | 1947-1973 | Christenson, Cumings, and Jorgenson (1980) | 5.3 | 34 | 2 | 64 |
| 2 | 1960-1995 | Jorgenson and Yip (2001) | 3.3 | 51 | 4 | 42 |
| 3 | 1961-1998 | European Commission (2000) | 3.07 | 35.8 | 3.6 | 60.6 |
| 4 | 1981-2001 | Bassanetti et al. (2004) | 1.84 | 42.1 | 31.6 | 26.3 |

This table reveals many interesting facts. First of all, we have considered four different sources. The first two are directly comparable, as both of them use the quality-adjusted capital and labour inputs. The European Commission, instead, uses the notion of capital stock and employment contributions, while Bassanetti *et al.* (2004) make use of a new measure of capital services, disaggregated into several components.

First, as we may expect, growth accounting gives different results depending on which method is used. In particular rows 2 and 3 allow for almost the same period, but the findings are opposite regarding the capital and TFP contribution.

Second, sub-periods present different characteristics. The period between 1947 and 1973 is covered only by the first source. It results that TFP growth accounts for more than two-third of the overall growth rate of real GDP per capita. For the following period, source 2 and 4 show a significant reduction of the contribution of TFP (the so-called productivity slowdown). Inconsistently with the other three studies, Bassanetti *et al.* found a significant contribution of labour to growth. Growth accounting studies tried to account for the heterogeneity of labour by considering differences in the quality of labour input. Diversities across workers with respect to categories of characteristics, where education is one of several categories including gender, age, and occupational characteristics, augment labour input. Differences in measuring variable that include human capital specification are not surprising.

Finally, from the study of the European Commission, it appears that TFP and capital accumulation were the two most relevant factors behind growth, while the employment contribution was very small. In particular, the contribution of TFP was approximately twice of the one of capital; instead, in the studies of Jorgenson and Yip and Bassanetti *et al.* capital contributes mostly to economic growth.

Many authors¹² in analysing the economic growth of a single country have considered growth accounting as first step. However, according to standard growth accounting, the proximate sources of growth operate independently of one another; in reality, there are interactions between technological progress and capital. Klenow and Rodríguez-Clare(1997), Hall and Jones (1999) and Barro and Sala-I-Martin (2004), argue that the standard growth decomposition overstates the contribution of capital

¹² Jorgenson, D. (1995,); Easterly and Levine (2001).

accumulation to growth by attributing to capital the effect on output of increases in capital induced by increases in TFP.

Moreover “accounting is no explanation”¹³. Traditional growth accounting exercises leave a considerable fraction of output growth unexplained: more research is needed. Conceptual and technical problems are related with TFP.

Therefore, these results should be further explored as to examine the fundamental sources of Italian economic growth.

3 The theoretical framework: the neoclassical model with human capital

We begin with an explicitly neoclassical framework that includes accumulation of human as well physical capital. It represents the basis for most empirical growth works; other theories have generally used the neoclassical model as a baseline from which to explore different approaches.

The central feature of this model is the assumption of diminishing returns to the reproducible factors of production.

The basic determinants of the level of output are the accumulation of physical and human capital. Physical capital exerts positive effect on the level of output: physical capital accumulation is the key of the Solow-Swan model: the economy will grow only if its investment rate is relatively high. Empirical evidence generally supports this idea: the new industrialised countries in the East Asia have investment rates of about 50%, while in Africa it is about 5%.

Micro-economic studies based on Mincerian human capital earnings function suggest significant return to education. Human capital plays a crucial role in determining the long-run economic growth, although the magnitude of its impact depends on the estimation approach and on the measure of human capital available.

The augmented neoclassical model was tested in Mankiw, Romer and Weil (1992) (MRW); they postulated that the model fits well the data and, in particular, the speed of convergence they obtained is in line with the theory.

We describe this model because the results of its estimation are used as a benchmark. Therefore following their approach, let us assume a framework in which production at time t is given by:

$$Y_t = F(K_t, H_t, A_t L_t)$$

Where Y , K , H , A and L are respectively output, physical and human capital, the level of technology and labour; therefore $A_t L_t$ is the number of effective units of labour. We are focusing on a Harrod neutral technology.

Assuming a Cobb-Douglas production function, it may be written as:

$$Y_t = K_t^\alpha H_t^\beta (A_t L_t)^{1-\alpha-\beta}$$

Labor force is assumed to obey $L_t = L_0 e^{n,t}$, where n is the population growth. According to standard neoclassical theory the growth rate of population has a negative correlation with the level of output per capita: a higher population growth rate reduces

¹³ Griliches, 1997.

the steady-state capital-output ratio because more investment must go simply to maintain the existing capital-output ratio in the growing population (i.e., the portion of economy's investment is used to provide capital for new workers rather than to raise capital per worker).

The level of technology is assumed to obey $A_t = A_0 e^{g \cdot t}$, where g is the rate of technological progress. We assume that the depreciation rate of both types of capital is constant and equal to δ .

In reality δ , n , g are not constant. The more a unit of physical capital is used, the more it depreciates. The population growth is:

$$n = \text{fertility} - \text{mortality} + \text{net migration}$$

These three variables depend on the economy. Theory suggests that higher level of income and technology may reduce fertility by increasing wages and thus the relative value of women's time and the overall opportunity cost of rising children; fertility is also reduced because, as the level of income increases, the "endowment" (in the sense of skills and education), given to the children increases as well. Under a general production function, there will be a period of increasing income and population growth rates, and that eventually income reaches a level \tilde{y} , after which population growth rate begins to fall¹⁴.

Finally the rate of technological progress is the ultimate source of growth in that neoclassical model; but some problems arise. It is unlikely to assume that it is constant, that is not affected by economic decisions. Furthermore according to neoclassical theory in a world of perfect competition, the total amount of output is devoted to pay only the inputs. There is no way to finance technology, the crucial source of growth.

Keeping these considerations in mind, let us suppose, in this first part, the validity of all the assumptions of the neoclassical model.

Although the description of the steady-state of the model can be found in textbooks presentations of works about growth, we briefly show it again.

Normalising with respect to $A_t L_t$, the production function in intensive form is:

$$y_{E,t} = k_t^\alpha h_t^\beta \quad (2)$$

where $y_{E,t}$ is the output per efficiency unit of labour.

Spending on education delivers returns of some sort, in much the same way as spending on fixed capital. Therefore investing in human capital is the counterpart to investing in fixed capital. The fraction of income invested in physical capital is s_k whereas the fraction invested in human capital is s_h .

$$\begin{aligned} \dot{K} &= s_k Y_t - \delta K_t \\ \dot{K} &= s_k k_t^\alpha h_t^\beta - (n + g + \delta) k_t \end{aligned}$$

Similarly, the human capital accumulation is:

¹⁴ See M. Kremer (1993), among the others.

$$\begin{aligned}\dot{H} &= s_h Y_t - \delta H_t \\ \dot{H} &= s_h k_t^\alpha h_t^\beta - (n + g + \delta) h_t\end{aligned}$$

In the steady state equilibrium, we should have:

$$k = \left(\frac{s_k h^\beta}{n + g + \delta} \right)^{\frac{1}{1-\alpha}} \quad (3)$$

$$h = \left(\frac{s_h k^\alpha}{n + g + \delta} \right)^{\frac{1}{1-\beta}} \quad (4)$$

By solving the system, we get:

$$\begin{aligned}h^* &= \left(\frac{s_H^{1-\alpha} s_K^\alpha}{n + g + \delta} \right)^{\frac{1}{1-\alpha-\beta}} \\ k^* &= \left(\frac{s_H^\beta s_K^{1-\beta}}{n + g + \delta} \right)^{\frac{1}{1-\alpha-\beta}}\end{aligned}$$

From the definition of the production function, we have:

$$\frac{Y_t}{L_t} = A(0) e^{gt} \left(\frac{s_H^\beta s_K^{1-\beta}}{n + g + \delta} \right)^{\frac{\alpha}{1-\alpha-\beta}} \left(\frac{s_H^{1-\alpha} s_K^\alpha}{n + g + \delta} \right)^{\frac{\beta}{1-\alpha-\beta}} \quad (5)$$

Taking the logs, the output per capita is:

$$\ln \left[\frac{Y_t}{L_t} \right] = \ln A(0) + gt + \frac{\alpha}{1-\alpha-\beta} \ln s_k + \frac{\beta}{1-\alpha-\beta} \ln s_H - \frac{\alpha+\beta}{1-\alpha-\beta} \ln (n + g + \delta) \quad (6)$$

As suggested by MRW, the input “human capital” can be expressed in two different ways: the level of human capital and the rate of accumulation of human capital. In eq. (6), the rate of accumulation, s_H , is considered. By putting in the production function (eq. 2) the steady state value of physical capital (eq. 3), the output per capita in the logarithm specification can be expressed in terms of the level of human capital, h ,

$$\ln \left[\frac{Y_t}{L_t} \right] = \ln A(0) + gt + \frac{\alpha}{1-\alpha} \ln s_k + \frac{\beta}{1-\alpha} \ln h^* - \frac{\alpha}{1-\alpha} \ln (n + g + \delta) \quad (7)$$

Therefore empirical analysis of the model should check if the data available on human capital correspond more closely to the level of human capital or to the rate of accumulation of it.

Equation (7)¹⁵ would be a valid specification in the empirical analysis only if the country is in its steady state, that is all the variables in the economy grow at their long-run growth rate. When observed growth rate includes out-of-steady-state dynamics, the transitional dynamics should be explicitly modelled as follows.

Let $y^{E,*}$ be the steady-state level of output per effective worker, let y_t^E be the actual value at time t and $y_t = \frac{Y_t}{L_t}$. By approximating in the neighbourhood of the steady-state, a differential equation generates the convergence path:

$$\frac{d \ln(y_t)}{dt} = \mu [\ln(y^*) - \ln(y_t)] \quad , \text{ with } \mu = (n + g + \delta) (1 - \alpha - \beta) \quad (8)$$

where μ is a parameter that measures the rate of convergence of $y_{E,t}$ to its steady-state value.

Solving the first order linear differential equation yields:

$$\log y_{t,E} = (1 - e^{-\mu t}) \log y_{E}^* + e^{-\mu t} \log y_{E,0} \quad (9)$$

where $y_{E,t} = \frac{Y_t}{A_t L_t}$, y_{E}^* is the steady state value of y_E .

We can re-write equation (9) in terms of the observable variable y_t :

$$\begin{aligned} \log \frac{Y_t}{A_t L_t} &= (1 - e^{-\mu t}) \log y_{E}^* + e^{-\mu t} \log y_{E,0} \\ \log y_t &= g t + \log A_0 + (1 - e^{-\mu t}) \log y_{E}^* + e^{-\mu t} \log y_0 - e^{-\mu t} \log A_0 \end{aligned} \quad (10)$$

Rearranging, we get:

$$\begin{aligned} \log y_t - \log y_0 &= (1 - e^{-\mu t}) \frac{\alpha}{1 - \alpha} \ln s_k + (1 - e^{-\mu t}) \frac{\beta}{1 - \alpha} \ln h^* - (1 - e^{-\mu t}) \\ &\quad \frac{\alpha}{1 - \alpha} \ln (n + g) - (1 - e^{-\mu t}) \log y_0 \end{aligned} \quad (10.bis)$$

Following the approach of Durlauf, Johnson and Temple (2004), we can express equation (10) in terms of growth rate, instead of difference. Let the growth rate of output per worker between 0 and t , γ , be equal to:

$$\gamma = t^{-1} (\log y_t - \log y_0) \quad (11)$$

Dividing (11) by t and subtracting $\log y_0$ from both sides, we get:

$$\gamma = g + (1 - e^{-\mu t}) (\log y_0 + \log y_{E}^* + \log A_0) \quad (12)$$

¹⁵ This is called a level specification because the level of human and physical capital affects the level of output per capita.

Substituting the value of y^*_E in equation (7), equation (12) becomes:

$$\gamma = g + (1 - e^{-\mu t}) \left[\log y_0 + \ln A(0) + \frac{\alpha}{1 - \alpha} \ln s_k + \frac{\beta}{1 - \alpha} \ln h^* - \frac{\alpha}{1 - \alpha} \ln (n + g + \delta) \right] \quad (13)$$

The equation is linear in the logs of various observable variables and therefore open to standard regression analysis.

4 Quantitative analysis

The model developed in the previous section provides a framework for analysing both the level of output and economic growth. In this section we apply this model to understand Italian economic performance after 1950. First, however, we begin by documenting quantitatively the behaviour of the key variables emphasized in the model.

4.1 Data and descriptive statistics

The variables considered here include GDP, physical and human capital, population growth. We use data on real national accounts, compiled by Heston, Summers and Aten (2002), known as Penn World Table Version 6.1; the other data come from ISTAT.

Following standard practice, real GDP per capita is the indicator of economic growth.

In every model physical capital has always been considered a key determinants of economic growth. The rate of accumulation of physical capital is proxied by the quantity of real domestic investment, also known as gross capital formation in real GDP per capita. By definition (OECD), gross capital formation is measured by the total value of the gross fixed capital formation, changes in inventories and acquisitions, less disposals, of valuables for a unit or sector.

Regarding human capital, a first methodological issue is how to define and measure skills and competencies over time. It is quite complicated to know how close proxies such as school enrolment ratio, the number of graduates, average years of education or the proportion of the labour force which has received secondary school, are to their theoretical equivalents. Two types of measurement errors may emerge: first, data recording errors. Then, even when data are perfectly recorded, the measured variable may still be a poor measure of the true variable. This is particularly true for human capital.

Given the availability of the data, it is not possible to consider wider definition of human capital investment compassing on-the-job training, experience and learning-by-doing, and ignoring its depreciation. The quality of education cannot be taken into account. The proxies of human capital here considered are:

- the primary, secondary and tertiary enrolment ratios, defined as the ratio of total number of students enrolled in this level to the total number of persons in the corresponding age group;

- the number of students enrolled for primary, secondary and tertiary education;
- the number of graduate students.

Human capital may also have an effect on other factors, which affect growth, so that investments in education would have an additional indirect effect on economic performance. Its externalities, largely emphasized in literature, cannot be easily measured.

As in several studies, the rate of population growth is used instead of the rate of increase in labour input. Although not really the exact proxy, use of the former has some advantages: data on population are fairly good, whereas good and long time series on labour force are difficult to find.

A preliminary glance at graphs¹⁶ of most economic time series show that the data do not come from stationary processes. Nearly all time-series show permanent growth over time. Time series preliminary analysis involves running unit root tests.

The first step involves running augmented Dickey and Fuller and Phillips and Perron unit root tests. According to both tests, all the series are nonstationary and all of them are integrated of order one, even varying the number of the lags. The results from the ADF unit root tests are reported in table A1 in the appendix.

There are two different types of non-stationarity processes, such as those with deterministic trend plus a stationary stochastic process with mean zero and those with stochastic trend. The trend-stationary process has the form:

$$y_t = \alpha + \beta t + u_t, \quad \psi(L) u_t = \xi(L) \varepsilon_t, \quad \varepsilon_t \sim \text{i.i.d.}(0, \sigma_\varepsilon^2)$$

where u_t represents deviations from the trend, α and β are fixed parameters, and the polynomials $\psi(L)$ and $\xi(L)$ satisfy the conditions for stationarity and invertibility. In this case, the nonstationarity is caused by the presence of a deterministic time trend in the process, rather than by the presence of a unit root. With such a trending pattern a time series is non-stationary and it does not show a tendency of mean reversion.

The second type, the difference-stationary process, can be written as:

$$y_t = \beta + y_{t-1} + v_t, \quad \theta(L) v_t = \zeta(L) \varepsilon_t, \quad \varepsilon_t \sim \text{i.i.d.}(0, \sigma_\varepsilon^2)$$

where the polynomials $\theta(L)$ v_t and $\zeta(L)$ satisfy the conditions for stationarity and invertibility.

In practice, it can be quite difficult to distinguish between the two processes; but the distinction becomes crucial in order to calculate the effects of fluctuations on long-term growth. The time series properties of real output levels have been of special interest for their implications. Nelson and Plosser (1982) pointed out that the modelling of real output as either trend stationary or a difference stationary process has important implication for macroeconomic policy, modelling, testing and forecasting. This investigation can help determine whether fiscal and/or monetary stabilisation policies would likely have only temporary effects on real output. In their model, the stochastic trend contributes more to the variation in output than does the

¹⁶ See the appendix.

transitory component. They argued that an economic implication of this finding is that real shocks are much more important than previously thought, since they will have a permanent impact on output.

Stimulated by their work, there is an increasing amount of recent works that provide evidence that macroeconomic time series contain important stochastic trends. Macroeconomic policy might affect not only the temporary but also the permanent movements in economic activity. Given the crucial implications, we examine the time series properties of real GDP. The degree of persistence of the shocks should be analysed in order to estimate the magnitude of the permanent component of a time series.

The sample autocorrelations of log real GDP per capita in figure A.7 in the appendix are initially positive and tend to remain positive; however, they decline to zero as the lag length increases. This indicates large persistence, suggesting that there may be a non-stationary component to the series not eliminated by simply removing a deterministic trend.

There are mainly two ways of analysing the presence in a series of both a deterministic trend and an I(1) component. The first consists in running ADF unit root test, which contains the intercept term and the trend. The test does not reject the null hypothesis of unit root in the series, even including the intercept and the trend.

An alternative approach is suggested by Cochrane (1988), who criticized the use of unit root tests to determine the long run dynamic properties of a time series. He proposed non-parametric estimates of the persistence, the variance ratio, equal to the ratio of the variance of the j^{th} difference to the variance of the first difference, normalized by the factor j^{-1} :

$$V_j = j^{-1} \frac{\text{var}(y_t - y_{t-j})}{\text{var}(y_t - y_{t-1})}$$

If a series is integrated it can be always decomposed into a random walk plus a stationary component (Beveridge and Nelson, 1981); the variance ratio approaches the ratio of the variance of the random walk to the variance of the first difference, so it is unity for a pure random walk. If a series is trend stationary, the variance ratio approaches zero. There is “a continuous range of possibilities between zero and one and beyond one”¹⁷.

Even taking high values of j ($j = 35$ and $j = 40$), the variance ratios for annual log real GDP per capita are 1.40 and 0.82 respectively. First of all, these values approach to one, showing a large random walk component. Secondly, as we might expect, as the lags increase, the random walk component decreases, and that is why the variance ratio declines. The nonparametric estimates confirm that the random walk component in real GDP per capita is high: shocks have a long-lasting effect on output.

However, studying the univariate time series characterisation of GDP leaves unknown the sources of fluctuations of that variable; further analysis should be carried out.

¹⁷ Cochrane (1988).

4.2 Estimation technique: Regression results and interpretation

In this section, we report the results of estimating time series regression in the form of (7), section 3; this equation can be estimated in different ways. We first follow a pure time-series approach, using OLS. Alternative approach consists in the ECM representation.

The basic results are illustrated in table II.

Table II

| Dependent variable: log of real GDP per capita | |
|--|-----------|
| Observations | 47 |
| Constant | 0.71*** |
| Log (Investment) | 0.44*** |
| Log (Tertiary) | 0.38*** |
| Log (n) | - 0.06*** |
| aR ² | 0.994 |
| AIC | - 3.67 |

***: significant at the 1 percent level

All the coefficients are significant at 1 percent level and they have the expected sign. The model selection criteria are quite high.

In the literature, the proxy of human capital mainly considered is school enrolment ratio for secondary education in the population mainly; but in Italy higher level of education is more significant because of its contribution to increasing productivity. The Italian industry sector heavily depends on technological progress, and therefore it requires highly qualified labour force. The type of education provided at secondary level does not contribute enough to economic performance.

In fact, the proxy of human capital that fits better¹⁸ is the number of students enrolled for tertiary education; the coefficient on the number of students enrolled for primary education is even negative, while the one on the number of students enrolled for secondary is positive but significant only at 10 percent level. Primary education does not have considerable implication in determining the level of output.

Adding a dummy variable representing the introduction of PhD in Italy, it results that it has a positive and significant (at 1 percent level) impact on the level of output per capita; its coefficient is equal to 0.108.

The coefficient on physical capital (the [partial] elasticity of output with respect to physical capital, holding human capital constant) shows that a 1 per cent increase in the capital led on average to a 0.44 increase in the output. While the coefficient on human capital (the [partial] elasticity of output with respect to human capital, holding physical capital constant) shows that a 1 per cent increase in the human capital led on average to a 0.38 increase in the output.

Furthermore it is possible to infer the value of α and β in the Cobb-Douglas production function (1). The value of α , physical capital's share on income, is approximately one third (0.30), while β is slightly less than one third (0.27); these results basically confirm the theoretical literature about factor shares, considering that

¹⁸ According to the AI and the Schwartz criteria.

determining a reasonable value of β is quite problematic. Probably the fact that β is slightly less than one third suggests us that human capital is not paid its marginal product; it might reveal frictions in the labour market or something else.

Although population growth cannot be characterized as “the most important element in economic progress”¹⁹, empirical results suggest that an exogenous drop in birth rates raises the growth rate of output per capita.

These results have two main limitations: first of all, the variables are not stationary. Secondly, in a pure time series approach, business cycle dynamics may influence growth process. We cannot simply transforming the time series to stationary by first differencing notably because of the risk of losing information on the long-run relationship of the variables. As we are adopting a time series approach, the existence of long run relationship is crucial.

Then the existence of a cointegrating relationship among the variables that constitute the model has to be tested for. The original Engle-Granger procedure suggests to run the equation (7) in levels above and testing whether the residuals are $I(1)$. This procedure is not only not recommended in most cases, but also gives us marginal results.

Another test for cointegration consists in formulating the ECM: given the equation:

$$\Delta y_t = \gamma_0 + \Delta \gamma_1 x_t + \phi \hat{u}_{t-1},$$

where y_t is the level of GDP, x_t is the vector of regressors, and \hat{u}_{t-1} are the residuals estimated in the long-run relationship between y_t and x_t and they provide the empirical basis for the cointegration test. The hypothesis of non-cointegration ($\phi = 0$) is rejected; to test the hypothesis, critical values are taken from Mackinnon (1999) since critical values from the standard Dickey-Fuller tables would not be appropriate. Therefore series are cointegrated.

According to the Granger’s representation theorem, if variables are cointegrated, then there exists an error correction mechanism model representation of their relationship.

When dealing with the dilemma of non-stationary series, the error correction model has the advantage to combine long-run information with a short-run adjustment mechanism. This methodology has also been used successfully in other time-series growth studies²⁰. In such a way, time series can be decomposed into long-term trends and short-term fluctuations. The short-term dynamics of the variables in the system are influenced by deviations from the long-run equilibrium.

The ECM may be estimated in two ways. Banerjee et al. (1993) show that the generalized “one step” ECM is a transformation of an Autoregressive Distributed Lags (ARDL) model. So it can be used to estimate relationship between non-stationary processes. It can be written as follows:

¹⁹ Barro, (1997).

²⁰ See Nehru and Dareshwar (1994) and Morales (1998) among the others.

$$\Delta \ln \left[\frac{Y_t}{L_t} \right] = \gamma_1 \Delta \ln s_k + \gamma_2 \Delta \ln h + \gamma_3 \left(\ln \left[\frac{Y_{t-1}}{L_{t-1}} \right] + \frac{\alpha}{1-\alpha} \ln s_{k-1} + \frac{\beta}{1-\alpha} \ln h_{t-1} + \ln(A) \right) + \varepsilon_t$$

However the equation cannot be estimated by OLS since the variables in parenthesis cannot be formed without a knowledge of α and β . Therefore the following reparametrized form is estimated:

$$\Delta \ln \left[\frac{Y_t}{L_t} \right] = \gamma_0 \ln A + \gamma_1 \Delta \ln s_k + \gamma_2 \Delta \ln h + \gamma_3 \ln \left[\frac{Y_{t-1}}{L_{t-1}} \right] + \gamma_4 \ln s_{k-1} + \gamma_5 \ln h_{t-1} + \varepsilon_t \quad (E1)$$

The required elasticities α and β can be now calculated using the estimates of the parameter γ_3 . The coefficient γ_3 contains additional information because it can be interpreted as a measure of the speed of adjustment in which the system moves towards its equilibrium on the average.

In the so-called “two-step” procedure [Engle and Granger (1987)] the error correction term EC_{t-1} is derived from the lagged residuals ε_t of equation (7), that can be used to estimate the following equation (used also to test for cointegration):

$$\Delta \ln \left[\frac{Y_t}{L_t} \right] = \gamma_0 \ln A + \gamma_1 \Delta \ln s_k + \gamma_2 \Delta \ln h + \gamma_3 EC_{t-1} + \varepsilon_t \quad (E2)$$

Therefore the dynamics do not need to be specified until the error correction structure has been estimated.

Equations (E1) and (E2) should in principle yield similar results because both formulations can be understood as a transformation of each other. Table 3 illustrates the results.

Table III

| Dependent variable: log difference of real GDP per capita | | |
|---|------------|-----------|
| | E1 | E2 |
| Constant | 0.147*** | 0.020*** |
| $\Delta \text{Log (Investment)}$ | 0.265*** | 0.289*** |
| $\Delta \text{Log (H)}$ | 0.038 | 0.100*** |
| Log (GDP) [-1] | - 0.078*** | |
| $\text{Log (Investment) [-1]}$ | 0.045** | |
| Log (H) [-1] | 0.018 | |
| Error-correction term [-1] | | - 0.12*** |
| Long-term output elasticity of K | 0.30 | 0.30 |
| Long-term output elasticity of H | 0.27 | 0.27 |
| a-R ² | 0.84 | 0.80 |
| AIC | - 6.34 | - 6.12 |
| F-statistic | 51.07 | 57.13 |

*** : significant at the 1 percent level

** : significant at the 5 percent level

* : significant at the 10 percent level

4.3 Some implications of the regression results

Table III reveals many interesting facts.

The speed of adjustment to the long-run growth path is given by the coefficient of the term measuring the deviations of actual GDP with respect to its potential. Its negative value ensures that the system is not explosive but comes back to its equilibrium path. Any deviations or errors from the long-run equilibrium path are corrected (hence, the term error correction). That coefficient is statistically significant at 1 percent level, negative and equal to -0.12 ; this means that 12 per cent of the gap between the actual and the potential output tends to be eliminated each year. The speed of adjustment is quite moderate: after a certain shock to the economy it would take at least approximately 20 years to reach the level of output consistent with long-run growth.

Investment rate plays a crucial role. Moreover the coefficients of both the models are quite similar, demonstrating for certain aspect the robustness of this regressor. Investment is a fundamental source of growth.

The empirical specification in the “one-step” procedure does not confirm the role of human capital. The coefficients, both in level and in difference, are not statistically significant; it might be that this specific measure of human capital is not appropriate.

Though human capital is not statistically significant, the “one-step” procedure, showing the short-run dynamics, should be preferred according the model selection criteria. Anyway according the F-statistic the coefficients are jointly significant.

These results regarding human capital need some explanation. Human capital may not be significant because the major part of people currently enrolled in Universities is not yet a part of labour force, so that the education that they are acquiring cannot yet be used in production. Furthermore, the education of students may not translate into additions to the human capital embodied in the labour force because some graduates may not participate in the labour force and because part of current enrolment may be wasted due to grade repetition and dropping out. All the similar analyses in which it is significant use average years of schooling as its proxy²¹. Divergent outcomes for econometric growth studies are not surprising: estimation should be performed in strictly comparable conditions with the same data, the same sample and the same model. Complex characteristics embrace the concept of human capital, which are difficult to measure with precision.

But this result might suggest us something else. What is human capital as input different from labour?

Let us recall equation (1):

$$Y_t = K_t^\alpha H_t^\beta (A_t L_t)^{1-\alpha-\beta}$$

The neoclassical model augmented with human capital is not completely precise in the definition of L, input different from human capital. In particular if β is the share on income that goes to human capital, it is not exactly known to whom $(1 - \alpha - \beta)$ goes, even if L is defined as uneducated labour.

²¹ Actually we do not have this kind of data.

Therefore it might be that factor inputs are not correctly specified. Barro, Mankiw and Sala-I-Martin, (1995) suggested to consider everything as “k”, a broad concept of capital that incorporates human and physical components.

5 The “policy-and-institutions” augmented growth model

The standard growth models lead to the startling conclusion that there is no growth in per capita terms, except for the possibility of exogenous technological change. Moreover in the traditional growth model, economic policies do not play any role in shaping long-term economic growth. Neoclassical model holds many things constant; relaxing some its assumptions gives room for policy to affect growth.

The main message of the endogenous growth theories is that the long-term growth rate is determined by government policies and other institutional, deterministic and political factors (such as the trade policy, the financial system, monetary sector, the institutions and the administration, protection of intellectual property rights). These policies affect permanently the long run growth of the economy.

There is, yet, little agreement on the exact mechanisms linking policy setting to growth. Considering the general production function at time t :

$$Y_t = F(K_t, H_t, A_t L_t)$$

A natural step to remedy the problem of inexplicable sustained growth consists in try to endogenize the process of technological progress. The “policy-and-institutions augmented growth model”²² assumes that the level of technological efficiency A_t has two components:

- 1) Z_t , dependent on economic policies; Z_t represents policy variables affecting growth. They typically include a number of variables that capture the role of policies, such as real government expenditure and economic system indicators;
- 2) T_t , the level of technological progress:
 - $A_t = (Z_t)(T_t)$;
 - $\ln Z_t = \sum_i b_i \ln K_{i,t}$
 - $\dot{T} = g T_t$

By considering the component of technological efficiency, the theoretical growth model becomes:

$$\gamma = g + (1 - e^{-\mu t}) \left[\log y_0 + \frac{\alpha}{1 - \alpha} \ln s_k + \frac{\beta}{1 - \alpha} \ln h^* - \frac{\alpha}{1 - \alpha} \ln (n + g + \delta) + \sum_i b_i \ln K_{i,t} \right] \quad (14)$$

In such equation, instead of concentrating on only one endogenous variable (it can be government size or trade), we consider the impact of all of them on growth. This approach implies the estimation of the following equation:

$$\gamma = \beta_0 + \beta_1 X + \beta_2 W + \varepsilon_t$$

²² Bassanini, A., S. Scarpetta and P. Hemmings, (2001).

where the X variables represent the growth determinants suggested by the augmented Solow growth model. The W variables are the growth determinants, the explanatory variables related with the policy measures. These variables are supposed to have growth, and not level effects on output; the extension will allow us to understand the impacts that particular policies might have had on the long-run behaviour of the Italian economy. Their impact and significance are discussed below in brief.

Government size

In the basic growth models, economic policies are inefficacious in the long-run. In the Solow's and Ramsey's (1928) models of competitive equilibrium, the government cannot bring in efficiency; public consumption and the way in which it is financed do not influence growth rates. In particular, in the Ramsey model, an increase of government consumption implies a reduction in disposable income and therefore a reduction in private consumption, with no effects on capital. In the overlapping generations framework²³, government policy has only level effects; however, the growth rate of the economy is determined in the long run only by exogenous variables and government policies do not play any role.

The theoretical link between government policy and output growth is provided by Barro (1990), Kneller, Bleaney and Gemmell (1999) and Bleaney, Gemmell and Kneller (2001), among the others.

The overall size of government in the economy may influence growth in two opposite directions. On one hand, government size might be harmful to efficiency and economic growth for the following reasons:

- High tax rates may imply economic distortions; in general, taxes are growth reducing. People invest less in assets that are taxed;
- Government may in fact allocate resources poorly: nothing ensures that its actions are executed efficiently;
- Public bureaucracy may involve diseconomies of scale, increasing burdens, barriers and obstacles to the economic activity.

On the other hand government size exercises positive effect on economic performance:

- In presence of market failures, government intervention can ensure the social optimum for growth and development: for example, government can avoid exploitation of the so-called "commons"; it can harmonize conflicts between social and private interests; or it can address resources where they are required. Basically governments provide rules to make markets work efficiently and take corrective actions when markets fail.

Renewed interest has been regarded the composition of government spending. Government activities can be divided in productive and unproductive. The former are expected to be growth – promoting while the latter growth – retarding; education and infrastructure represent the typical "directly" productive public expenditure. In the Barro (1990) model the growth effects of various government tax and expenditure policies depend on their classification as one of four types. Decreases in distortionary

²³ See Samuelson (1958) and Diamond (1965).

taxes and increases in productive expenditure raise the steady state rate of growth, while non-distortionary and non-productive expenditure have no direct effect. In this model, the analysis of the chosen method of financing the government budget constraint is fundamental to examine the growth effect of any particular change in fiscal policy on growth.

Government plays a role in financing formal schooling and formal schooling is generally considered a key channel for human capital accumulation. Therefore there is a potential link between public education expenditures and growth. The overall result depends on the size of the government, the tax structure and on the parameters of the production technologies.

As Fischer (1993) point out, deficit can negatively influence economic growth through its effects on capital accumulation. Deficit can be considered as an indicator of unstable and unsustainable macroeconomic policy environment. In the short run, growth may be higher during high deficit period, because of the assistance of high saving rates and financial repression; but in the long run, the negative relationship emerges.

There is no ideal size for the state, and size alone does not capture its full effect on markets. On theoretical grounds, there has been a controversy: the general view is that public expenditure can be growth enhancing but the financing of such expenditures can be growth retarding. The overall impact depends on the trade-offs between the productivity of public expenditure and the distortionary effects. Theory offers little guidance.

Empirically no consistent evidence exists for a significant relationship between government spending and growth, in a positive or negative direction [Kormendi – Meguire (1985) and Grier-Tullock (1989)]. Results of significant correlations differ by country, and even region, analytical method and categorisation of government expenditure; also the link between growth and government spending on education has not been validated empirically. Levine-Renelt (1992) and Easterly-Rebelo (1993) provide good surveys of empirical results.

For Italy we are not going to do any particular assumptions, but we follow the proposition “let the data show”.

Monetary sector

The literature on economic growth has paid great attention to the effects of changes in the rate of money creation and in the rate of inflation on real variables. Monetary growth theory can be made to yield a variety of qualitatively different results, depending upon which model is used. Three different theories can be distinguished:

- i) Tobin’s (1965) “descriptive” approach asserted that money is not superneutral; there is a positive relationship between the rate of inflation and growth;
- ii) According to Sidrauski (1967), in a model with rational choices in infinite horizon, money is superneutral; the equilibrium value of capital intensity does not depend on growth rate of money;
- iii) Stockman (1981) considered a model with liquidity constraints on investment²⁴. If there are constraints both in the consumption and investment

²⁴ See Chirichiello, 2000.

decisions, a prediction opposite to Tobin's emerges; with constraint only on consumption decisions, Sidrauski's conclusion is confirmed.

Models of endogenous growth consent to test the relationship between money and growth. The monetary neutrality hypothesis asserts that the growth of real output is not linked to the anticipated growth of money supply. Including as regressors the growth of monetary aggregates seems to be a natural way to test the neutrality theory.

In recent years the empirical evidence has been in favour of the negative relationship between rate of inflation and growth [Kormendi and Meguire (1985), De Gregorio (1993), Levine and Renelt (1992), Rubini and Sala-i-Martin (1992)]. A recurring theme is that inflation increases uncertainty; it will tend to introduce undesirable noise into the workings of markets, raising, for instance, relative price variability. Planning will become more difficult and, if inflation is at least perceived to be costly, this belief may become self-fulfilling²⁵.

Some empirical results [Briault, (1995) and Kocherlakota (1996)] suggest that inflation is harmful but the evidence is not overwhelming. The basic finding is that higher inflation goes along with a lower rate of economic growth, but inflation up to 20 percent a year may or may not go.

Financial system

The role of financial system in the growth process has received recently considerable attention.

Greenwood and Jovanovic (1990) examined the relations between growth and income distribution and between financial structure and economic development. In their model, financial structure has positive effects on economic growth due to more efficient undertaking of investment and more efficient capital allocation.

Atje and Jovanovic (1993) found that there is a positive effect of stock markets on the level as well as on economic growth. According to Berthelemy and Varoudakis (1996), growth rate is positively affected by the number of the banks, or the degree of competitiveness of the financial system.

Different reasons justify the positive relationship between financial system and growth. Generally speaking, an efficient and vibrant financial system is an important precondition for private sector development: financial market plays a vital role in the savings-investment decision. Financial instruments, markets and institutions arise to mitigate the effects of information and transaction costs [Levine, R., (1997)]. The financial system mobilizes savings and allocates them to investments by private entrepreneurs. It links savers and borrowers, manage risks, and operate the payment and settlement systems. And it helps shift resource from declining to dynamic sectors.

The endogenous growth literature stressed the influence of financial system on economic growth [Bencivenga et al.(1995), Greenwood and Smith(1997), Obstfeld(1994), among the others]. In an AK model, Pagano (1993) concluded that financial deepening affects growth by converting saving to investment. Benhabib and Spiegel (2000) suggested that financial development affects growth both through its contribution to factor accumulation rates and total factor productivity growth.

²⁵ Heymann and Leijonhufvud (1995), Temple (2000a).

Empirical works on the relationship between financial development and economic growth are growing, but they often reach different conclusions; empirical results are very sensitive to model specification. Cross-country and panel data studies find positive effects of financial system on growth, while time series studies give conflicting results, such as in Arestis and Demetriades (1997). Demetriades and Hussein (1996) found also little systematic evidence of positive relation.

Beck et al. (1999) have stressed the importance of having a wide variety of indicators that measure the size (relative and absolute), the activity and the efficiency of financial intermediaries and market.

The banking sector, the size of liquidity of the stock market, the level of the banking sector development and stock market development play a crucial role. The span of the data is much more significant than the number of observations²⁶; it is preferable to utilize data set containing over a long time period than data sets containing more observations over a short time period. In fact, many data sets of financial indicators contain data only every five years interval.

The proxies of financial development here used are:

- Domestic credit to private sector;
- Market capitalization;
- Liquid liabilities.

1.3.5 Trade policy

There are several channels, stressed by trade theory, through which trade can stimulate growth. With the example of the pin factory, Adam Smith has first pointed out that trade increases market size and promotes specialization, which increases productivity and growth; this argument is also the basis of various models (e.g. Grossman and Helpman, 1991).

Trade policy is expected to have desirable growth effects through a strategy of export promotion, which reduces trade restrictions, improves economic openness, increases competitiveness, and enhances efficiency.

Within the framework of New Growth Theories, openness and technology play a crucial role in the process of growth. Openness in foreign trade favours the exchange of ideas and technology transfer, thus producing a more rapid diffusion of new products, processes and research between national economies. Coe and Helpman (1995) and Coe, Helpman, and Hoffmaister (1997) found evidence of substantial R&D spillovers from industrial countries in the North to other industrial countries and to less developed countries in the South. Therefore these effects promote the accumulation of knowledge and human capital²⁷.

Policies that reduce tariff barriers and dismantle non-tariff barriers would therefore suggest positive gain from trade. Openness to trade allows countries to benefit both static and dynamic efficiencies.

Successful entry into international markets has become associated with the rapid growth of the Asian NICs. There are several alternative interpretation of this success:

²⁶ Campbell and Perron (1991).

²⁷ Bregman and Marom, (1993), among the others.

it is not clear if the key factor is trade per se and the resultant gain from specialisation, or competition and the associated pressure for cost minimization, or both.

The correlation between openness and growth has been estimated to be positive in the empirical growth literature; however, some recent studies have been more dubious and found that the statistical significance of this correlation depends on the empirical model and the proxy variable for openness [Vamvakidis, A. (2002)]. In addition the progress on the empirical side has been slower due to the fact that it is difficult to interpret the causality issue. Frankel and Romer (1999) solved the problem of endogeneity using geographical variables, showing that trade causes growth.

Another group of studies has argued that economic strategy should not be based only on openness, but also on good macroeconomic policies, efficient institutions and domestic trade policy cannot be set independently of the trade policy followed by the rest of the world²⁸.

Though there is some ambiguous evidence, trade protection is by no means an element of growth strategy.

The aim of these macro regressions is to investigate the respective role of the various “inputs” in contributing to economic growth, thus shedding some light on the Italian economic performance, and helping to identify those policy measures most likely to enhance growth.

The lack of broadly agreed theoretical bases for empirical work motivated some researchers to largely abandon any *a priori* reasoning and let the data show what is most consistently correlated with economic growth. This is a pure empirical approach.

5 .1 Additional data

It is now interesting to adopt the approach “let the data show” in order to analyse the empirical determinants of growth according to the “policy-and-institutions” augmented growth model.

The variables considered here include various measures of government size, monetary and financial system, and trade sector.

The size of the public sector can be measured by alternative indicators: we use government share of real output, growth rate of government expenditure, government expenditure on education and deficit/GDP ratio.

Our estimates are based on three variables that proxy for openness to international trade: the amount of real exports, the amount of real imports and openness, measured by export plus import divided by real GDP. Indicators of monetary sector are growth of money supply and rate of inflation.

Table IV shows all the potential variables affecting growth.

²⁸ Rodriguez and Rodrik, (1999); Clerides et al. (1998); Bhagwati-Srinivasan (1985).

Table IV. Description of additional variables

| Variable | Description and source | Years |
|-----------------------------------|---|-----------|
| Gov't consumption share | Share of government consumption to real GDP. PWT 6.1 | 1950-2000 |
| Gov't spending on education | Share of spending on education to real GDP. OCSE | 1950-1995 |
| Deficit | Budget primary deficit/ GDP. IMF | 1950-2000 |
| Inflation | Average inflation rate (CPI). Bank of Italy | 1950-2004 |
| Money growth | Growth of money supply. IMF | 1950-2000 |
| Openness | Ratio of exports plus imports to real GDP. PWT 6.1 | 1950-2000 |
| Export | Ratio of export to real GDP. IMF | 1950-2004 |
| Import | Ratio of import to GDP. IMF | 1950-2000 |
| Stock market capitalisation | Or market value: is the share price times the number of share outstanding. IMF | 1989-1999 |
| Domestic credit to private sector | Financial resources provided to the private sector that establish a claim for repayment. IMF's International Financial Statistics or, when the broader aggregate is not available, from its monetary survey ²⁹ . | 1960-2003 |
| Liquid Liabilities (M3) | Sum of M0, M1, M2, plus travellers checks, foreign currency time deposits, commercial paper, and shares of mutual funds or market funds held by residents. IMF | 1960-2003 |

A time series analysis of these variables reveals that they are integrated of order 1 (see table A1 in the appendix). All the variables are I(1) in level, and in a time series approach it is necessary to make them stationary, differently from the similar cross-country studies.

5.2 Pure empirical growth approach

The pure empirical approach can be done in two different ways, depending on the specification of the model. While appealing, this approach requires a departure from the classical structure in which conditioning on a model is fundamental³⁰.

The regressors are measured not as a share of GDP, but in level. At the beginning we test the following regression:

$$\Delta \text{Log(gdp)} = \beta_0 + \beta_1 \Delta \text{log(Investment)} + \beta_2 \Delta \text{log(gov. consum)} + \beta_3 \Delta \text{log(exp. education)} + \beta_4 \Delta \text{log(exports)} + \beta_5 \log(\text{inflation}) + \beta_6 \Delta \text{log(money)} + \varepsilon_t \quad (15)$$

Tab. V illustrates the results.

²⁹ The monetary surveys includes monetary authorities (the central bank) and deposit money banks. In addition to these, the banking survey includes other banking institutions such as savings and loan institutions, finance companies, and development banks.

³⁰ Sala-i-Martin et al., (2004).

Table V

| Dependent variable: log difference of real GDP per capita | |
|---|------------|
| Observations | 43 |
| Constant | 0.02*** |
| $\Delta \log$ (Investment) | 0.24*** |
| $\Delta \log$ (gov. consumption) | - 0.03*** |
| $\Delta \log$ (gov. exp. education) | 0.08*** |
| $\Delta \log$ (exports) | 0.03* |
| $\Delta \log$ (money) | 0.09*** |
| \log (inflation) | - 0.005*** |
| AR ² | 0.88 |
| AIC | - 6.66 |
| F-statistic | 53.78 |

*** : significant at the 1 percent level

** : significant at the 5 percent level

* : significant at the 10 percent level

From the baseline estimation, the variables that seem to be related with growth are:

- The log difference of *investment*; as it is expected, the coefficient is not only significant (at 1 per cent level), but also positive as the theory predicts;
- A greater volume of *non-productive government spending* (and the associated taxation) reduces the growth rate of output per capita³¹. In this sense, big government is “bad for growth”³².
- But there is evidence of positive link between log difference of output and government spending on education. Although the impact of total government expenditure appears to be negative, the conclusion is sensitive to the categories of expenditure examined;
- The log difference of *exports*, with a positive and significant (only at 10 percent level) coefficient. It is interesting to note that the measure of openness (defined as the ratio of export plus import to GDP) is not statistically significant in this particular specification;
- The coefficient on inflation is negative and significant; this confirm not only the Stockman’s (1981) hypothesis, but also the recent similar results in literature;
- The coefficient on money supply is positive and significant, violating the neutrality of money.

The other variables of tab. III are not statistically significant within this specification. In particular, the proxies of financial development do not seem to be related with the log difference of output; this is in line with time series evidence. Furthermore this result is not surprising, because Italy has begun a process of financial development during the 1990s, exactly when there was the productivity slowdown.

³¹ Micossi and Tullio (1992) also found a negative coefficient on public expenditure in an analogous time series study of Italy.

³² Barro, (1997).

Overall, the results suggest a significant impact of macro policy settings on output per capita over time.

First differencing appears, *prima facie*, to provide the appropriate solution to deal with non-stationary series. First differencing, however, has a limitation: there is no way to obtain long-run information, namely long-run steady-state relationship.

Again, we consider an error correction model also for testing the model of endogenous growth; the ECM incorporates both the short and the long run effects.

First of all the following long-run relationship is tested:

$$\text{Log(gdp)} = \beta_0 + \beta_1 \log(\text{Investment}) + \beta_2 \log(\text{Human capital}) + \beta_3 \log(n + g + \delta) + \beta_4 \log(\text{openness}) + \beta_5 \log(\text{gov. consum}) + \beta_6 \log(\text{exp. education}) + \varepsilon_t \quad (16)$$

The residuals of this regression are used to

- run the Augmented Dickey-Fuller unit root test: it results that they are stationary at 1% level;
- formulate the dynamic ECM.

We label the regressors of equation (16) by K. The unrestricted form is:

$$\Delta \text{Log(gdp)} = \beta_0 + B_1 \Delta \log(K) + \beta_2 \log(\text{gdp})_{-1} + B_7 \log(K)_{-1} + u_t \quad (E1)$$

While the ECM is:

$$\Delta \text{Log(gdp)} = \beta_0 + B_1 \Delta \log(K) + \beta_2 \text{EC}_{t-1} + u_t \quad (E2)$$

Results are reported in table VI.

Table VI

| Dependent variable: log difference of real GDP per capita | | |
|---|------------|-----------|
| | (E1) | (E2) |
| Constant | 0.705*** | 0.015*** |
| $\Delta \text{Log (Investment)}$ | 0.222*** | 0.230*** |
| $\Delta \text{Log (H)}$ | 0.022 | 0.068*** |
| $\Delta \text{Log (openness)}$ | 0.065** | 0.084** |
| $\Delta \text{Log (gov. consump)}$ | - 0.031*** | - 0.021** |
| $\Delta \text{Log (exp. educ)}$ | 0.064*** | 0.106*** |
| Log (GDP) [-1] | - 0.135*** | |
| $\text{Log (Investment) [-1]}$ | 0.021 | |
| Log (H) [-1] | - 0.005 | |
| $\text{Log (openness) [-1]}$ | 0.065** | |
| $\text{Log (gov.consump) [-1]}$ | 0.002 | |
| Log (exp.educ) | 0.042 | |
| Error-correction term [-1] | | - 0.22** |
| a-R ² | 0.90 | 0.89 |
| AIC | - 6.79 | - 6.73 |
| F-statistic | 38.18 | 58.90 |

*** : significant at the 1 percent level
 ** : significant at the 5 percent level
 * : significant at the 10 percent level

From table VI considerations similar to the ones associated with table III can be done, mainly for the following points: the coefficients of human capital are not statistically significant in the “one-step” procedure; the negative and statistically significant coefficient of the speed of adjustment ensures that the system is not explosive. The coefficients on investment have almost the same value both in E1 and E2 model, confirming its unambiguously positive effect on growth.

Regressions of table VI produce better estimates in compare to the ones of table III, where government and trade sector were not considered. Therefore empirically comparing the results of the neoclassical model with human capital to those of the pure empirical growth approach, it results that, *coeteris paribus*, the latter is better. By regression results, models of endogenous growth give better estimates.

6 Robustness analysis

In order to reach accurate conclusions, further analysis can be useful.

Empirical works on growth are not supported by a consensus theoretical framework; the new growth theories based on the pure empirical approach can be open ended: two or three of them can be true at the same time, while one of them puts emphasis on specific fiscal-expenditure variables, or monetary policy indicators, proxies of financial development, etc.

In table V there are a high number of variables that has been found to be correlated with growth in at least one regression. In this section robustness analysis is carried out in order to know which variables are “truly” correlated with growth. Robustness analysis becomes crucial in order to discriminate between a potential quasi-infinite numbers of variables, determinants of growth.

As Leamer (1983, 1985) suggested, the choice of the right-hand side variables in a regression equation is inevitably based on assumption. Leamer argued that inferences are robust if the specification assumptions are broad enough to be credible, namely the assumptions include a wide set of possible independent variables based on relevant literature; and if the interval of inferences is narrow enough to be useful, that is, the coefficient estimates should be statistically significant given some conventional decision rule.

Levine and Renelt (1992) have applied a variant of the extreme-bound analysis (EBA henceforth) proposed by Leamer (1983, 1985) to test the robustness of coefficient estimates to alterations in the conditioning set of information.

According to EBA, three sets of variables can be distinguished: *i*) the **K** variables, always included in the regression; *ii*) the **J** variable of interest; *iii*) and the **Z** variables (maximum three), chosen from a pool of variables. The regression has the following form:

$$\Delta \text{Log}(\text{gdp}) = \beta_0 + \beta_k \mathbf{K} + \beta_j \mathbf{J} + \beta_z \mathbf{Z} + \varepsilon_t$$

By estimating this regression for all possible \mathbf{Z} combinations, each model provides an estimation of β_j . The upper (lower) extreme bound is the largest (lowest) value of β_j + (-) two standard deviations, over all possible models. The rule for defining fragile a variable according to EBA is the following: if the lower extreme bound is negative and the upper extreme bound is positive, then the variable is fragile.

Analysing the robustness of the Italian determinant of growth according to the EBA, we made the following assumptions:

- The K variable is only Investment: according to past empirical studies and economic theory, it is strongly related with growth;
- In the \mathbf{Z} set variables that might measure the same phenomenon are excluded in order to avoid increase in the standard deviation.

6.1 Growth dynamics

Levine and Renelt (1992) employ a version of this test considering the growth model: equations of type (15), section 5.2, are considered.

The total amount of regressors is 12; if the investment is the “constant” variable, the total number of combinations of possible models is considered.

Table VII shows the results for all the possible combinations.

Table VII. Sensitivity results

| J-variable | Coefficient | a-R ² | Sensitivity result |
|-------------------------|----------------|------------------|--------------------|
| Δ Tertiary | base: 0.081 | 0.737 | fragile (1) |
| Δ Gov.consump. | high: - 0.019 | 0.756 | robust |
| | base: - 0.020 | 0.733 | |
| | low: - 0.029 | 0.841 | |
| Δ Gov. exp. edu | base: 0.118 | 0.820 | fragile (3) |
| Δ Deficit | base: 0.011 | 0.755 | fragile (1) |
| Δ Openess | base: 0.104 | 0.732 | fragile (1) |
| Δ Export | base: 0.036 | 0.721 | fragile (0) |
| Δ Import | base: 0.022 | 0.711 | fragile (0) |
| Δ Money | base: 0.080 | 0.791 | fragile (1) |
| Δ L. Liab. | base: 0.107 | 0.789 | fragile (1) |
| Δ Dcredit privat | base: 0.025 | 0.663 | fragile (0) |
| Inflation | base: 5.62E-05 | 0.702 | fragile (0) |

Notes: L. Liab. Stands for liquid liabilities; Dcredit privat stands for domestic credit to private sector.

The base coefficient is estimated with the variable of interest and the only k-variable (investment). Fragile (0) indicates that the variable is fragile when regressed only with the k-variable; fragile (*i*), with *i* = 1,2,3, means how many variables should be added before the variable becomes fragile or insignificant.

Not surprisingly, very few variables are robustly related with growth: government consumption and investment (by assumption). Government consumption has always the same sign (negative) and it is robust if the growth dynamics is considered. The gap

between the maximum and the minimum point estimates of the focus coefficient is considerably small.

The implications are clear: the unproductive government consumption is clearly growth retarding. The negative relationship may also suggest the inefficiency associated with the use of it. This finding is coherent with the model of Barro (1990): government consumption has no direct effect on “private-sector productivity, but does lead to a higher income tax rate. Since individuals retain a smaller fraction of their returns from investment, they have less incentive to invest, and the economy tends to grow at a lower rate”.

The variables, proxies of financial and trade sectors, do not matter for growth according to EBA. The log difference of human capital is fragile; again this is not surprising, because similar studies have found human capital is not relevant if measured in difference.

EBA, as the same name suggest, is, probably, too extreme. There are two more lenient criteria:

- the “ R^2 decision rule” (Granger and Uhlig, (1990)); the extreme bounds is chosen according some threshold of overall fit related with the value of the R^2 ;
- the Bayesian Averaging of Classical Estimates (BACE) Approach (Sala-I-Martin et al. (2004)): limiting the effect of prior information, weighted averages of all the estimates of the j -coefficient and its corresponding standard deviations are constructed, using weights proportional to the likelihoods of each of the models. In such a way, it is assigned some “level of confidence” to each variable.

Anyway EBA, although imperfect, has been a useful remedy for model uncertainty.

7 Test of endogenous versus exogenous growth models.

Another advantage of the time series approach consists in the possibility of testing endogenous versus exogenous growth models. Whether a permanent change in economic policy variables produces a change in the long-run growth rate of the economy is an empirical question that many economists and policy makers are interested in. Moreover, it is a distinguish characteristic between endogenous and exogenous growth models because the change leads to a growth effect in the former class of models, while a level effect in the latter. Jones (1995) and Kocherlakota and Yi (1996) performed empirical analysis through simple time series analysis.

Jones (1995) argued that time series evidence of major industrialised countries is unfavourable to two classes of endogenous growth models: the AK-style models and the R&D-based models. His results are based on articulate analysis of time series properties of GDP, its growth rate, investment rate, the number of scientists and engineers engaged in R&D and TFP growth. The degree of persistence in the series is analysed in order to discriminate empirically between the exogenous growth model and endogenous growth model. If permanent changes in policy variables do not have permanent and large effects on growth rates of GDP per capita³³, the “hallmark

³³ This is what the data show.

endogenous growth models is misleading". The empirical estimates of the AK model confirm the lack of permanent effects of investment rate on growth rate of GDP.

Kocherlakota and Yi (1996, 1997) [KY], instead, founded their work on the following consideration: according to the exogenous growth models, temporary innovations in government policies cannot affect the long-run level of GDP, while according the endogenous growth models they can³⁴. They developed a statistical test based on regressing growth rate³⁵ on lagged policy variables: the sum of the coefficients on the lags of policy variables should be zero in the exogenous growth model. They reached the opposite conclusion of Jones': empirical evidence is in favour of endogenous growth model. Not surprisingly, qualitatively different results emerge depending upon which model is used.

We adopt the model of KY and some of its assumptions because of consistency with section 5: we have not developed theoretically any particular model of endogenous growth, preferring the pure empirical growth approach. Jones, instead, refers to two specific classes of models; furthermore, given the constraint of available data, R&D-based growth models cannot be tested.

We consider the same policy variables that [KY] did: the tax rate (X_1) and the ratio of government spending on education to real GDP (X_2)³⁶.

The following equation is estimated:

$$\text{Growth rate of GDP } (\gamma) = b_0 + \sum_{n=1}^i b_{1,n} \ln(X_{1,t-n}) + \sum_{n=1}^i b_{2,n} \ln(X_{2,t-n}) + \varepsilon_t$$

Table VIII shows the results.

Table VIII

| Dependent variable: growth rate of real GDP per capita | | |
|--|--|---------------------|
| | Null Hypothesis | X ² test |
| 1 | $H_0: \sum_{n=1}^3 b_1 = 0$ | 12.83*** |
| 2 | $H_0: \sum_{n=1}^5 b_1 = 0$ | 8.23*** |
| 3 | $H_0: \sum_{n=1}^3 b_2 = 0$ | 13.99*** |
| 4 | $H_0: \sum_{n=1}^5 b_2 = 0$ | 12.06*** |
| 5 | $H_0: \sum_{n=1}^3 b_1 = \sum_{n=1}^3 b_2 = 0$ | 5.90** |

***: p-value of hypothesis test < 0.01

**: p-value of hypothesis test < 0.05

*: p-value of hypothesis test < 0.10

³⁴ See King, Plosser and Rebelo (1988).

³⁵ Fischer and Seater (1993) explained the use of growth rate in the regression for making inferences on permanent changes in GDP levels.

³⁶ A spending variable and a revenue variable.

In the first two rows, only government spending on education is considered, with $n = 3$ and 5 respectively; in the following 2 rows, only tax rate is considered, with $n = 3$ and 5. Using both variables with three lags gives the results in row 5. The null hypothesis is that the sum of coefficients is equal to zero, in accordance with the exogenous growth models.

From table VIII, some considerations can be done. First of all, all of these sums are statistically different from zero. Both in regressions with only one variable and regressions with the two variables, the null hypothesis is rejected at 1 per cent level for regressions with one variable and 2 per cent level for both variables. Tax rates and government spending on education have economically and statistically significant effects on growth rate. Furthermore, their opposite effects do not offset each other. Therefore there is strong evidence in favour of endogenous growth models for Italy. Government policy variables seem to play an important role; “government policy is important in shaping long-run or persistent growth”³⁷. These results are consistent with those in the previous section.

8 Some considerations about causality

A final consideration should be done. A recurring issue in this literature is the “causality versus correlation”³⁸ question. The positive or negative associations between macro-variables and economic growth are insufficient in establishing what is the cause and what is the effect. Growth regressions do little to establish directions of causation. Growth accounting is different from causality too.

The regression results should take into account the problem of causality: are policy variables jointly determined with growth rate of GDP or even does the growth rate of GDP determine them? Bean (1990) and Ireland (1990) examined the Granger-causality implications of endogenous versus exogenous growth models and the evidence was in favour of endogenous model.

There are several ways to deal with this issue. The first way consists in assuming that causality is known a priori, given specific theoretical models. The above estimations and analyses assume that all the right-hand side variables are exogenously determined. In practice, however, output may in turn determine them or be determined jointly with them. This can lead to simultaneity bias when error term is correlated with one or more explanatory variables. Most empirical studies admit the simultaneity problem in measuring the impact of macro-determinants on growth, but few of them account for it³⁹.

The most common response has been the application of instrumental variable procedures; the search of instruments might be easy at first glance: a variety of

³⁷ Easterly et al., (1994).

³⁸ Brock and Durlauf (2001).

³⁹ Barro and Sala-i-Martin (2004), De Long and Summers (1991), Bond, Leclercicoiglu and Schiantarelli (2004), Frankel and Romer (1999), Rousseau and Wachtel (2002), among the others.

instruments has been proposed⁴⁰. Many instruments are typically chosen only because they are in some sense exogenous, that is, they are predetermined with respect to the error term. Predetermined variables, however, are not necessarily valid instruments; in practice, finding appropriate instruments is a complex task.

Another simple way consists in using bivariate Granger causality test to explore the connection between growth and its determinants. We interpret regressors to be Granger-causing growth when a prediction of growth on the basis of its past history can be improved by further taking into account the previous of previous period's regressors. The first and most famous application of Granger causality was to the question "does money growth cause changes in GNP?" Friedman and Schwartz (1963) documented a correlation between money growth and GNP, and a tendency for money changes to lead GNP changes. But Tobin (1965) pointed out that a phase lead and a correlation may not indicate causality. Sims (1972) applied a Granger causality test, which answered Tobin's statement. In his first work, Sims found that money Granger causes GNP but not vice versa, although he and others have found different results afterwards.

In this section we apply the third way (Granger causality test); but a more deeply analysis is carried out for the relation between growth and investment given its important positive role.

The positive and statistically significant coefficient on the contemporaneous investment in a growth regression might be a sign of the positive relationship between investment and "growth opportunities"⁴¹, instead of the positive effect of an exogenous higher investment on the growth rate.

Barro (1997) suggested regressing the potential determinants of growth on investment, considered as explanatory variable. We consider as regressors the five variables in table VIII: government consumption, government spending on education, real exports, money and inflation. Only inflation is statistically significant, and it exerts a negative effect on investment: the sole policy variable, which affects economic growth partly by stimulating investment, is inflation. This is a reasonable result given the effects of uncertainty about prices on economic decisions: relative price variability makes planning more difficult. Not surprisingly the other four variables are not related with investment⁴².

Blomstrom, Lipsey and Zejan (1996) [BLZ] applied the Granger-Sims causality tests, considering also following period variable. They test the following equation:

$$\gamma_t = b_0 + \sum_{n=1}^i b_{1,n} \gamma_{t-n} + \sum_{n=0}^i b_{2,n} I_{t-n+1} + \epsilon_t,$$

where γ is growth rate of real GDP per capita, I is the ratio of fixed capital formation to GDP, and the null hypothesis is always that of non-causation.

⁴⁰ See Durlauf et al. (2004) for wide list.

⁴¹ Barro, 1997.

⁴² We expect that variables like taxes, interest rates, rule of law index, democracy index, might be related to investment.

Table IX

| Dependent variable: growth rate of real GDP per capita | | | |
|--|---------|---------|----------|
| | Model 1 | Model 2 | Model 3 |
| γ_{t-1} | 0.32** | 0.24 | 0.05 |
| γ_{t-2} | 0.13 | 0.06 | |
| I_{t+1} | | | 0.18 |
| I_t | | | 1.12*** |
| I_{t-1} | | 0.12 | -0.99*** |
| a-R ² | 0.11 | 0.11 | 0.72 |
| AIC | 4.54 | 4.56 | 3.41 |

***: significant at the 1 percent level

**: significant at the 5 percent level

*: significant at the 10 percent level

Significant considerations can be done. From model 1 and 2, it results that past history of growth is not a particularly useful predictor of current growth and lagged investment does not improve the estimates. Model 3, instead, reveals interesting facts. Lagged and current investment are the only variables statistically significant; the finding that investment in the previous period has a negative coefficient is probably due to the high correlation between past and current investment. Future investment does not have correlation with current growth. This reveals unidirectional causality between investment and growth rate; in fact, if causality runs only from investment to growth rate, then the future values of investment in the regression should have coefficients that are insignificantly different from zero⁴³. We reach the same conclusions regressing the growth rate of real GDP per capita on the logarithm of investment ratio.

We now consider the following stationary variables and we check if they Granger cause growth: difference of real exports, investment and the rate of inflation.

We choose the number of lags equal to three, considering that data are annual and that it is better to use more rather than fewer lags. From Granger causality test, we can reject the hypothesis that difference of real exports and investment does not Granger cause GDP growth, but we cannot reject the hypothesis that GDP does not Granger cause them. Therefore it appears that Granger causality runs one way from difference of real exports and investment to GDP growth and not the other way; this confirms the previous analysis about investment and the importance of exports as source of growth.

Two-way causation is, instead, the case for GDP growth and inflation. These two macro-variables are strictly interconnected, and choices of fiscal and monetary authorities have a great impact on both of them. The complex mechanism of inflation should be taken into account. Furthermore, when supply shocks are prevailing, the adverse supply shocks cause both inflation and slower growth, and the results may reflect this relationship⁴⁴.

“Granger causality”, however, is not causality in a more fundamental sense because of the possible influences of other variables.

⁴³ See Sims(1972).

⁴⁴ Fischer, (1993).

9 Conclusions

The analysis of economic growth has developed rapidly in the last twenty years, both on theoretical and empirical fronts. Theoretical and empirical works have interacted in a profitable way. In this paper, we have reviewed theoretical structure and empirical evidence regarding macrodeterminants of growth in Italy.

Growth accounting reveals that a large component of economic growth is unexplained; furthermore, different methods of accounting give substantially different results.

We have pointed out that the results obtained by cross-country regressions may not accurately reflect individual country characteristics. The econometric evidence we provide using time series estimations on Italy and time series properties of the data are in favour of endogenous growth models.

But before reaching policy conclusions, one “must look at everything”⁴⁵. Studies examining the robustness of explanatory variables⁴⁶ found that nothing is robust or most of the determinants of growth are regional, political and religious variables. In the latter case, the “top variable” is the dummy for East Asian countries, which has a positive impact on growth. Given these kinds of results, there is no room for policy. However, in this paper the sensitivity analysis has revealed that in Italy public sector matters in growth specification; government consumption retards economic growth. These considerations highlight on one hand the traditional inefficiency of the public sector, and on the other hand the necessity to address resources where they are growth promoting. Education, R&D and infrastructure are sectors in which government should invest; government intervention should be efficient, and mismanagement in the use of public resources should be avoided. High quality public investment in education generates high economic and social returns: education and research need to be increased.

But the connection “between good policy and growth is not mechanical”⁴⁷. Growth regressions cannot spit out precise policy solutions; policy decisions draw on a variety of information, but the associations of policy variables with growth provide a grounding in reality from which policy discussion can build.

On the other hand, we find evidence that in Italy investment is a key source of economic growth. Given its positive and fundamental role, research should study what drives investment and how it can be stimulated.

The evidence presented in this paper provides very little support to the view that finance is a leading sector in the process of economic growth, as in others time series studies [(Demetriades and Hussein, (1996)]. A longer data set on financial indicators is necessary: we have found data from 1960; as other relevant regressors, such as government spending on education, are reported from 1950 till 1990, the combination of them produces 35 observations, that is not recommended.

Regarding future research, this study requires much better measures of human capital attainment and an improved framework concerning the dynamic of human

⁴⁵ Jones, L. (1990).

⁴⁶ Levine, and Renelt (1992), Sala-i-Martin et al., (2004).

⁴⁷ Harberger, 1998.

capital accumulation. A “broad measure of capital”, including public and private expenditure on education, might be a better variable in order to test the validity of the neoclassical model and its crucial assumption of diminishing return to capital.

References

- Abramovitz, M., (1993), "The Search for the Sources of Growth: Areas of Ignorance, Old and New", *The Journal of Economic History*, 53, 2, 217-243.
- Antonelli, C., R. Marchionatti and S. Usai, (2000), "Productivity and External Knowledge: the Italian Case", Working Papers 00/9, Centro Ricerche Economiche CRENOS.
- Arestis , P. and P. Demetriades, (1996), "Finance and Growth: Institutional Considerations and Causality", Paper presented at the Royal Economic Society Annual Conference, Swansea University, April.
- Arestis , P. and P. Demetriades, (1997), "Financial Development and Economic Growth: assessing the evidence", *Economic Journal*, 107, 783-799.
- Atje, R., and B. Jovanovic, (1993), "Stock market and Development", *European Economic Review*, 37, 623-640.
- Banerjee, A., J. Dolado, J. Galbraith and D. Hendry, (1993), *Cointegration, Error Correction, and the Econometric Analysis of Non-stationary Data*, Oxford, Oxford University Press.
- Barro, R. (1990), "Government Spending in a Simple Model of Endogenous Growth", *Journal of Political Economy*, 98, 5, 103-125.
- Barro, R. (1991), "Economic Growth in a Cross Section of Countries", *Quarterly Journal of Economics*, 106, 2, 407-443.
- Barro, R. (1997), *Determinants of Growth*, Cambridge, MIT Press.
- Barro, R. (1999), "Notes on Growth Accounting", *Journal of Economic Growth*, 4, 119-137.
- Barro, R., G. Mankiw and X. Sala-i-Martin, (1999), "Capital Mobility in Neoclassical Models of Growth", *American Economic Review*, 85, 1, 103-115.
- Barro, R. and X. Sala-i-Martin, (1992), "Convergence", *Journal of Political Economy*, 100, 223-251.
- Barro, R. And X. Sala-i-Martin, (2004), *Economic Growth*, Cambridge, MIT Press.
- Bassanetti, A., M. Iommi, C. Jona-Lasinio and F. Zollino, (2004), "La Crescita dell'Economia Italiana negli Anni Novanta tra Ritardo Tecnologico e Rallentamento della Produttività", Temi di Discussione, Banca d'Italia, n.539.
- Bassanini, A., S. Scarpetta and P. Hemmings, (2001), "*Economic Growth: the role of policies and institutions. Panel data evidence from OECD countries*", OECD Economics Department Working Papers, no. 283.
- Baumol, W., (1986), "Productivity Growth, Convergence, and Welfare: What the Long Run Data Show", *American Economic Review*, 76, 5, 1072-1085.
- Bean, C., "Endogenous Growth and the Procyclical Behaviour of Productivity", *European Economic Review*, 34, 355-363.
- Beck, T., A. Demircuc-Kunt and R. Levine, (1999), "A New Database on Financial Development and Structure", *Policy Research Working Paper Series 2146*, the World Bank.
- Bencivenga, V. and B. Smith, (1991), "Financial Intermediation and Endogenous Growth", *Review of Economics and Studies*, 58, 195-209.
- Bencivenga, V., B. Smith and R. Starr, (1995), "Transaction Costs, Technological Choice and Endogenous Growth", *Journal of Economic Theory*, 67, 153-177.

- Benhabib, J. and M. Spiegel, (2000), "The Role of Financial Development in Growth and Investment", *Journal of Economic Growth*, 5, 341-360.
- Berthelemy, J., and A. Varoudakis, (1996), "Economic Growth, Convergence Clubs, and the role of Financial Development", *Oxford Economic Papers*, 48, 300-328.
- Beveridge, S. and C. Nelson, (1981), "A new Approach to Decomposition of Economic Time Series into Permanent and Transitory Components with Particular Attention to Measurement of "Business Cycle"", *Journal of Monetary Economics*, 7, 151-174.
- Bhagwati, N. and T. Srinivasan, (1985), "Trade Policy and Development", in G. Grossman, ed., *Dependence and Interdependence*, Oxford, Basil Blackwell, 88-122.
- Bleany, M., N. Gemmell and R. Kneller, (2001), "Testing the Endogenous Growth Model: Public Expenditure, Taxation, and Growth over the Long Run", *Canadian Journal of Economics*, 34(1), 36-57.
- Bloomstrom, M., R. Lipsey and M. Zejan, (1996), "Is Fixed Investment the Key to Growth?", *Quarterly Journal of Economics*, 111, 1, 269-276.
- Bond, S., A. Leblebicioglu and F. Schiantarelli, (2004), "Capital Accumulation and Growth: a New Look at the Empirical Evidence", *Nuffield College, Oxford, Working Paper n. 2004-W8*.
- Bregman, A. and A. Marom, (1993), "Causes of Growth in the Business Sector in Israel, 1958-1988", *Bank of Israel Discussion Paper*, 93.02.
- Briault, Clive, (1995), "The costs of Inflation", *Bank of England Quarterly Bulletin*, 35, 33-45.
- Brock, W. and S. Durlauf, (2001), "Growth Empirics and Reality", *The World Bank Economic Review*, vol. 15, no. 2, 229-272.
- Campbell, J. and P. Perron, (1991), "Pitfalls and Opportunities: What Macroeconomists Should Know About Unit Roots", in O. Blanchard and S. Fischer, eds, *NBER Macroeconomics annual 1991*, MIT Press, 141-201.
- Canton, E., (1996), "Business Cycles in a two-sector model of endogenous growth", Discussion Paper 116, Tilburg University, Centre for Economic Research.
- Cellini, R., (1995), "Modelli di Crescita e politiche Fiscali nel Lungo Periodo: una Rassegna", *Economia Politica*, 129-182.
- Cellini, R., (1995), "Le Parziali Econometrie della Crescita", *Rivista di Politica Economica*, Sett., 3-55.
- Chirichiello, G., (2000), *Intertemporal Macroeconomic models, Money and Rational Choice*, London, MacMillan.
- Christenson L., D. Cumings , and D. Jorgenson, (1980), "Economic Growth, 1947-1973: an international Comparison", in J. W. Kendrick and B. Vaccara (eds), *New Developments in Productivity Measurement and Analysis*. Studies in Income and Wealth, vol.41, Chicago.
- Clerides, K., S. Lach and J. Tybout, (1998), "Is Learning by Exporting Important? Micro-Dynamic Evidence from Colombia, Mexico, and Morocco", *Quarterly Journal of Economics*, 113 (3), 903-947.
- Cochrane, J., (1988), "How Big is the Random Walk in GNP", *Journal of Political Economy*, 96, 5, 893-920.
- Coe, D. and E. Helpman, (1995), "International R&D Spillovers", *European*

- Economic Review*, 39, 859-887.
- Coe, D., E. Helpman, and A. Hoffmaister, (1997), "North-South R&D Spillovers", *Economic Journal*, 107, 134-149.
- De Gregorio, J., (1993), "Inflation, Taxation and Long-Run Growth", *Journal of Monetary Economics*, 31, 271-98.
- De Long, J. and L. Summers, (1991), "Equipment Investment and Economic Growth", *Quarterly Journal of Economics*, 106, 369-406.
- Demetriades, P., and A. Hussein, (1996), "Does Financial Development Cause Economic Growth?" Time Series Evidence from 16 Countries", *Journal of Development Economics*, 51, 387-411.
- Denison, E., (1962), "Sources of Growth in the United States and the Alternatives Before Us", Supplement Paper 13, New York, Committee for Economic Development.
- Diamond, P., (1965), "National Debt in a Neoclassical Growth Model", *American Economic Review*, 55, 5, 1126-1150.
- Durlauf, S., P. Johnson and J. Temple, (2004), "Growth Econometrics", in the *Handbook of Economic Growth*, P. Aghion and S. Durlauf, eds., North-Holland.
- Easterly, W. and S. Rebelo, (1993), "Fiscal Policy and Economic Growth: An Empirical Investigation", *Journal of Monetary Economics*, 32(3), 417-459.
- Easterly, W. and D. Wetzel, (1989), "Policy Determinants of Growth. Survey of Theory and Evidence", *The World Bank Working Paper*, 343.
- Easterly, W. and R. Levine (2001), "It's not Factor Accumulation: Stylised Facts and Growth Models", *The World Bank Economic Review*, vol. 15, no. 2, 177-219.
- Engle, R.F. and C.W. Granger, (1987), "Cointegration and Error Correction: Representation, Estimation and Testing", *Econometrica*, 55, 251-276.
- European Commission, (2000), "Italy's Slow Growth in the 1990s. Facts, explanations and prospects", European Economy no.5, Brussels.
- Evans, P., (1998), "Using Panel Data to Evaluate Growth Theories", *International Economic Review*, 39(2), 295-306.
- Fatás, A., (2000a), "Do Business Cycles Cast Long Shadows? Short-Run Persistence and Economic Growth", *Journal of Economic Growth*, 5, 147-162.
- Fatás, A., (2000b), "Endogenous Growth and Stochastic Trends", *Journal of Monetary Economics*, 45, 107-128.
- Fischer, S., (1993), "The Role of Macroeconomic Factors in growth", *Journal of Monetary Economics*, 32, 485-512.
- Fischer, S. and J. Seater, (1993), "Long-Run Neutrality and Superneutrality in an ARIMA Framework", *American Economic Review*, 83 (3), 402-415.
- Frankel, J. and D. Romer, (1999), "Does Trade Cause Growth?", *American Economic Review*, 89 (3), 379-399.
- Friedman, M. and A. Schwartz (1963), "A Monetary History of the United States", Princeton University Press.
- Granger, C., (1963), "Processes Involving Feedback", *Information and Control*, 6, 28-48.
- Granger, C., (1969), "Investigating Casual Relations by Econometric Models and Cross-Spectral Methods", *Econometrica*, 37, 3, 424-438.
- Greenwood, J. and B. Jovanovic, (1990), "Financial Development and Economic

- Development", *Economic Development and Cultural Change*, 15, 257-268.
- Greenwood, J. and B. Smith, (1997), "Financial Markets in Development and the Development of Financial Market", *Journal of Economic Dynamic and Control*, 21, 181-268.
- Grier K.B. and G. Tullock, (1989), "An Empirical Analysis of Cross-National Economic Growth, 1951-1980", *Journal of Monetary Economics*, 24, 2, p. 259-276.
- Griliches, Z., (1997), "The Simon Kuznets Memorial Lecture", unpublished, Harvard University, October.
- Grossman, G. and E. Helpman, (1991), *Innovation and Growth in the Global Economy*, Cambridge, MA, MIT Press.
- Hall, R. and C. Jones, (1999), "Why Do Some Workers Produce so Much More Output per Worker than Others", *Quarterly Journal of Economics*, 114(1), 83-116.
- Harberger, A, (1998), "A Vision of the Growth Process", *American Economic Review*, 88 (1), 1-32.
- Hendry, D., (1986), "Econometric Modelling with Cointegrated Variables: An Overview", *Oxford Bulletin of Economics and Statistics*, 48, 201-212.
- Heston, A., R. Summers and B. Aten, (2002), Penn World Table Version 6.1, Centre for International Comparisons at the University of Pennsylvania (CICUP), October,
- Heyman, D. and A. Leijonhufvud, (1995), *High Inflation*, Oxford, Oxford University Press.
- Hsieh, C., (1998), "What Explains the Industrial Revolution in East Asia? Evidence from Factor Markets", Paper, University of California Berkeley.
- Ireland, P., (1990), "What Causes Growth?", manuscript, University of Chicago.
- Jones, C., (1995), "Time Series Tests of Endogenous Growth Models", *Quarterly Journal of Economics*, 110, 2, 495-525.
- Jones, C., (2002), "Sources of U.S. Economic Growth in a World of Ideas", *American Economic Review*, 92(1), 220-239.
- Jones, L. and R. Manuelli, (1990), "A convex Model of Equilibrium Growth: Theory and Policy Implications", *Journal of Political Economy*, 98, 5, 1008-1038.
- Jorgenson, D., (1963) "Capital Theory and Investment Behaviour", *American Economic Review*, 53 (2), 247-259.
- Jorgenson, D. and Z. Griliches, (1967) "The Explanation of Productivity Change", *Review of Economic Studies*, 34, 249-280.
- Jorgenson, D. and K. Stiroh, (2000), "Industry-level Productivity and Competitiveness between Canada and the United States", *American Economic Review Papers and Proceedings*, 90 (2), 161-167.
- Jorgenson, D. and E. Yip, (2001), "Whatever Happened to Productivity Growth?", in E. Dean. M. Harper, and C. Hulten, eds, *New Developments in Productivity Analysis*, 205-246, Chicago.
- King, R., C. Plosser and S. Rebelo, (1988), "Production, Growth and Business Cycle I. The Basic Neoclassical Model", *Journal of Monetary Economics*, 21, 195-232.
- King, R., C. Plosser and S. Rebelo, (1988), "Production, Growth and Business Cycle II. New Directions", *Journal of Monetary Economics*, 21, 309-341.

- Klenow, P., (2001), "Comment on "It's not Factor Accumulation: Stylised Facts and Growth Models", by Easterly W. and R. Levine (2001), *The World Bank Economic Review*, vol. 15, no. 2, 221-224.
- Klenow, P. and A. Rodriguez-Clare, (1997), "Economic Growth: A Review Essay", *Journal of Monetary Economics*, 40, 597-617.
- Kneller, R., M. Bleaney and N. Gemmel (1998), "Growth, Public Policy and the Government Budget Constraint: Evidence from OECD Countries", *Discussion Papers in Economics*, DP 98/14, University of Nottingham.
- Kocherlakota, N., (1996), "Discussion of Inflation and Growth", in *Price, Stability and Economic Growth*, Federal Reserve Bank of St. Louis, St. Louis.
- Kocherlakota, N. and K.-M. Yi, (1996), "A Simple Time Series Test of Endogenous Vs. Exogenous Growth Models: an Application to the United States", *Review of Economics and Statistics*, 126-134.
- Kocherlakota, N. and K.-M. Yi, (1997), "Is there Endogenous Long-Run Growth? Evidence from the United States and the United Kingdom", *Journal of Money, Credit and Banking*, 29, 2, 235-262.
- Kormendi, R. and P. Meguire, (1985), "Macroeconomic Determinants of Growth: Cross Country Evidence", *Journal of Monetary Economics*, 16, 2, 141-163.
- Kremer, M., (1993), "Population Growth and Technological Change: One Million B.C. To 1990", *Quarterly Journal of Economics*, 108, 3, 681-716.
- Levine, R. and D. Renelt, (1992), "A Sensitivity Analysis of Cross-Country Growth Regression", *American Economic Review*, 82, 4, 942-963.
- Levine, R., (1997), "Financial Development and Economic Growth: Views and Agenda", *Journal of Economic Literature*, 35, 688-726.
- Lucas, R., (1988), "On the Mechanism of Economic Development", *Journal of Monetary Economics*, 22, 3-42.
- MacKinnon, J.G., A. Haug and L. Michelis, (1999), "Numerical Distribution Functions of Likelihood Ratio Tests for Cointegration", *Journal of Applied Econometrics*, 14, 563-577.
- Mankiw, N., D. Romer, and D. Weil, (1992), "A Contribution to the Empirics of Economic Growth", *Quarterly Journal of Economics*, 107, 2, 407-437.
- Micossi, S: and G. Tullio, (1992), "Squilibri di Bilancio, Distorsioni Economiche e Performance di Lungo Periodo dell'Economia Italiana", *Rivista di Politica Economica*, 39-91.
- Morales, A., (1998), "Determinants of Growth in an Error-Correction Model for El Salvador", *IMF Working Paper*, 98/104.
- Nadiri, I., (1970), "Some Approach to the Theory and Measurement of Total Factor Productivity: A Survey", *Journal of Economic Literature*, 8, 1137-1177.
- Nehru, V. and A. Dhareeshwar, (1994), "New Estimates of Total Factor Productivity Growth for Developing and Industrial Countries", *World Bank Policy Research Working Paper*, 1313.
- Nelson, C. and C. Plosser, (1982), "Trends and Random Walks in Macroeconomic Time Series: some Evidence and Implications", *Journal of Monetary Economics*, 10, 139-162.
- Obstfeld, M., (1994), "Risk-taking, Global Diversification, and Growth", *American Economic Review*, 84, 10-29.

- Pagano, M., (1993), "Financial Markets and Growth", *European Economic Review*, 37, 613-622.
- Ramsey, F., (1928), "A Mathematical Theory of Saving", *Economic Journal*, 38, 4, 543-559.
- Rati, R., (1986), "Government Size and Economic Growth: a New Framework and Some Evidence from Cross-Section and Time-Series Data", *American Economic Review*, 76 (1), 191-203.
- Rodriguez, F. and D. Rodrick, (1999), "Trade Policy and Economic Growth: a Sceptic's Guide to the Cross-National Evidence", NBER Working Paper 7081.
- Romer, P.M., (1986), "Increasing Returns and Long-run Growth", *Journal of Political Economy*, 94, 5, 1002-1037.
- Romer, P.M., (1990), "Endogenous technological change", *Journal of Political Economy*, 98 (5), 71-102.
- Roubini, N. and X. Sala-I-Martin, (1992), "Financial Repression and Economic Growth", *Journal of Development Economics*, 39, 5-30.
- Rousseau, P. and P. Wachtel, (2002), "Inflation Thresholds and the Finance-Growth Nexus", *Journal of International Money and Finance*, 21, 6, 777-793.
- Sachs, J. and A. Warner, (1997), "Fundamental Sources of Long-Run Growth", *American Economic Review*, 87(2), 184-188.
- Sala-I-Martin, X., (1997), "I Just Ran Two Million Regressions", *American Economic Review*, 87 (2), 178-183.
- Sala-I-Martin, X., G. Doppelhofer and R. Miller, (2004), "Determinants of Long-Term Growth: a Bayesian Averaging of Classical Estimates (BACE) Approach", *American Economic Review*, 94 (4), 813-835.
- Samuelson, P., (1958), "An Exact Consumption-Loan Model of Interest with or without the Contrivance in Money", *Journal of Political Economy*, 66, 467-482.
- Sidrauski, M., (1967), "Rational Choice and Patterns of Growth in a Monetary Economy", *American Economic Review Papers and Proceedings*, 57, p.534-44.
- Sims, C., (1972), "Money, Income and Causality", *American Economic Review*, 540-552.
- Smyth, T., (1992), "The Cyclical Behaviour of Prices", *Journal of Money, Credit and Banking*, 24(2), 413-430.
- Solow, R.M., (1956), "A Contribution to the Theory of Economic Growth", *Quarterly Journal of Economics*, 70, 65-94.
- Solow, R.M., (1957), "Technical Change and the Aggregate Production Function", *Review of Economics and Statistics*, 39, 312-320.
- Stockman, A., (1981), "Anticipated Inflation and the Capital Stock in a Cash-in-Advance Economy", *Journal of Monetary Economics*, 8, 387-393.
- Temple, J., (1998), "Robustness Tests of Augmented Solow Model" *Journal of Applied Econometrics*, 13 (4), 361-375.
- Temple, J., (1999), "The New Growth Evidence", *Journal of Economic Literature*, 37, 112-156.
- Temple, J., (2000a), "Inflation and Growth: Stories Short and Tall", *Journal of Economic Surveys*, 14 (4), 395-426.
- Temple, J., (2000b), "Growth Regression and What the Textbooks Don't Tell You", *Bulletin of Economic Research*, 52 (3), 181-205.

- Temple, J., (2003), "The Long-Run Implications of Growth Theories", *Journal of Economic Surveys*, 17 (3), 497-510.
- Tobin, J., (1965), "Money and Economic Growth", *Econometrica*, 33, 671-84.
- Vamvakidis, A., (2002), "How Robust is the Growth-Openness Connection? Historical evidence", *Journal of Economic Growth*, 7, 57-80.

APPENDIX: DATA

Figure A1. Real GDP per capita in 1996 international dollars.

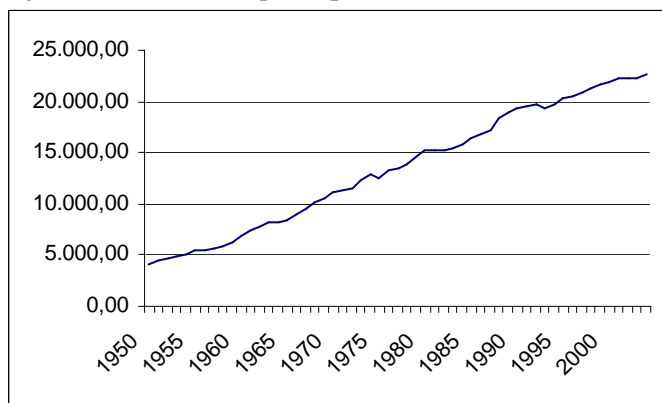


Figure A2. Real exports of goods and services in 1996 international dollars.

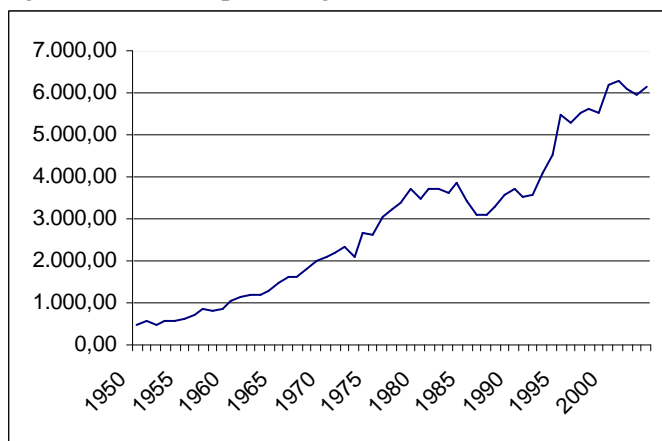


Figure A3. Government spending on education in 1996 international dollars.

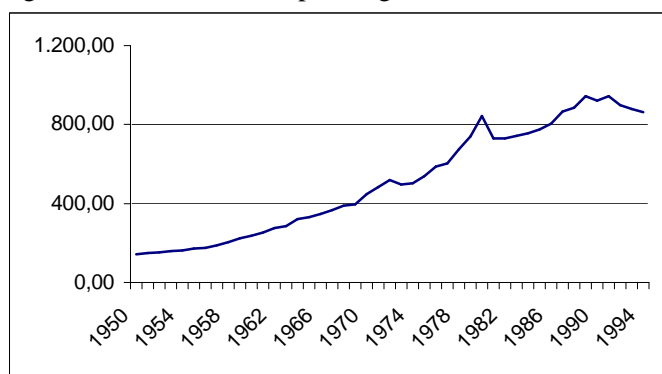


Figure A4. Investment ratio to GDP (%)

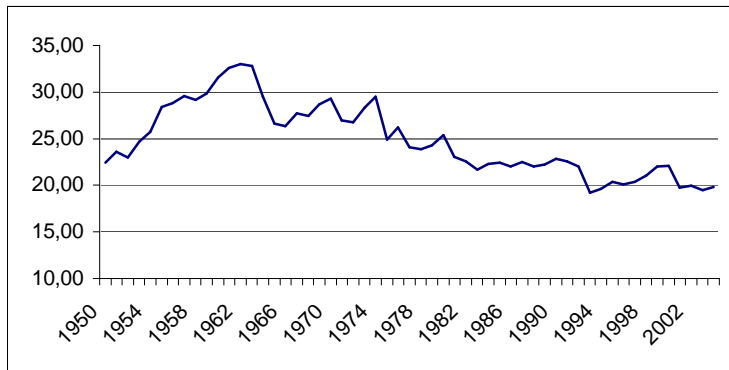


Figure A5. Growth rate of GDP.

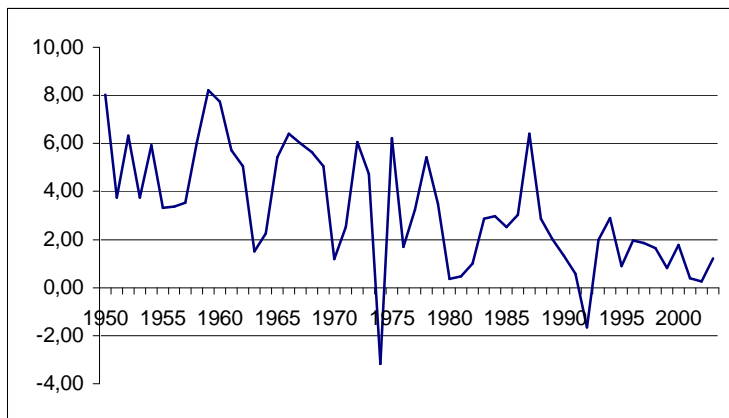


Figure A6. Rate of inflation.

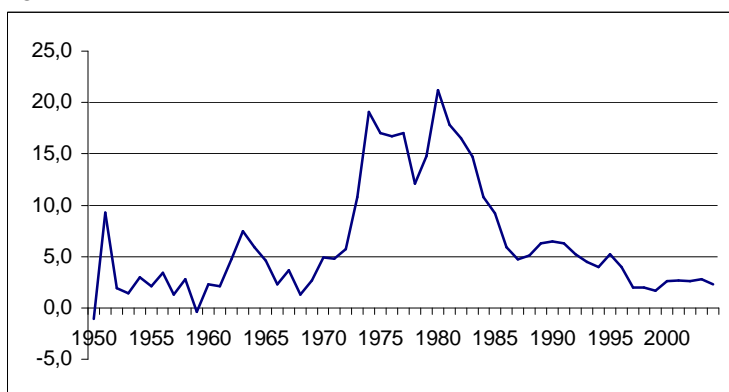


Figure A7. Autocorrelations of log real GDP per capita

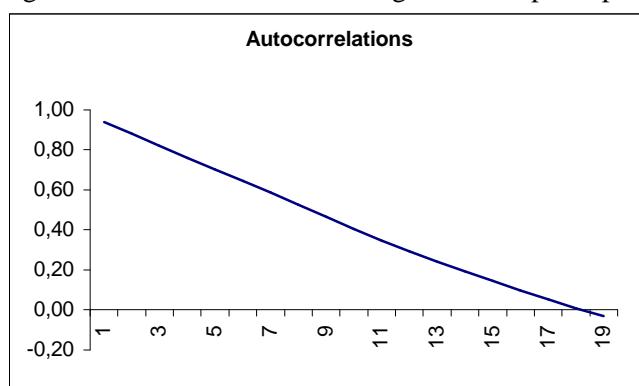


Table A1. ADF unit root test.

| Variable | ADF. Null Hypothesis: unit root in X | | | | |
|-----------------------------------|--------------------------------------|--------|----------|----------|-----------|
| | t-Statistic | Prob.* | 1% level | 5% level | 10% level |
| Real GDP per capita | -2.76 | 0.22 | -4.15 | -3.50 | -3.18 |
| Gov. spending education | -2.19 | 0.48 | -4.18 | -3.52 | -3.19 |
| Real Exports | 0.87 | 0.99 | -3.57 | -2.92 | -2.60 |
| Gov. consumption | -1.81 | 0.37 | -3.57 | -2.92 | -2.60 |
| Real Import | 0.25 | 0.97 | -3.57 | -2.92 | -2.60 |
| Inflation | -2.17 | 0.22 | -3.56 | -2.92 | -2.60 |
| Investment | -1.28 | 0.63 | -3.57 | -2.92 | -2.60 |
| Liquid Liabilities | -1.48 | 0.53 | -3.67 | -2.96 | -2.62 |
| Openness | -1.52 | 0.81 | -4.18 | -3.52 | -3.19 |
| Tertiary | 0.08 | 0.96 | -3.56 | -2.92 | -2.60 |
| Deficit | -1.31 | 0.62 | -3.57 | -2.92 | -2.60 |
| Domestic credit to private sector | -0.03 | 0.95 | -3.63 | -2.95 | -2.61 |
| Growth rate of GDP | -4.90 | 0.00 | -3.57 | -2.92 | -2.60 |

*MacKinnon (1996) one-sided p-values.